Bhamo
Lashio
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Mandalay
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Phnom Penh
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Singora
SOUTH
Sabang
Alor Star
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FEDERATION OF MALAYA
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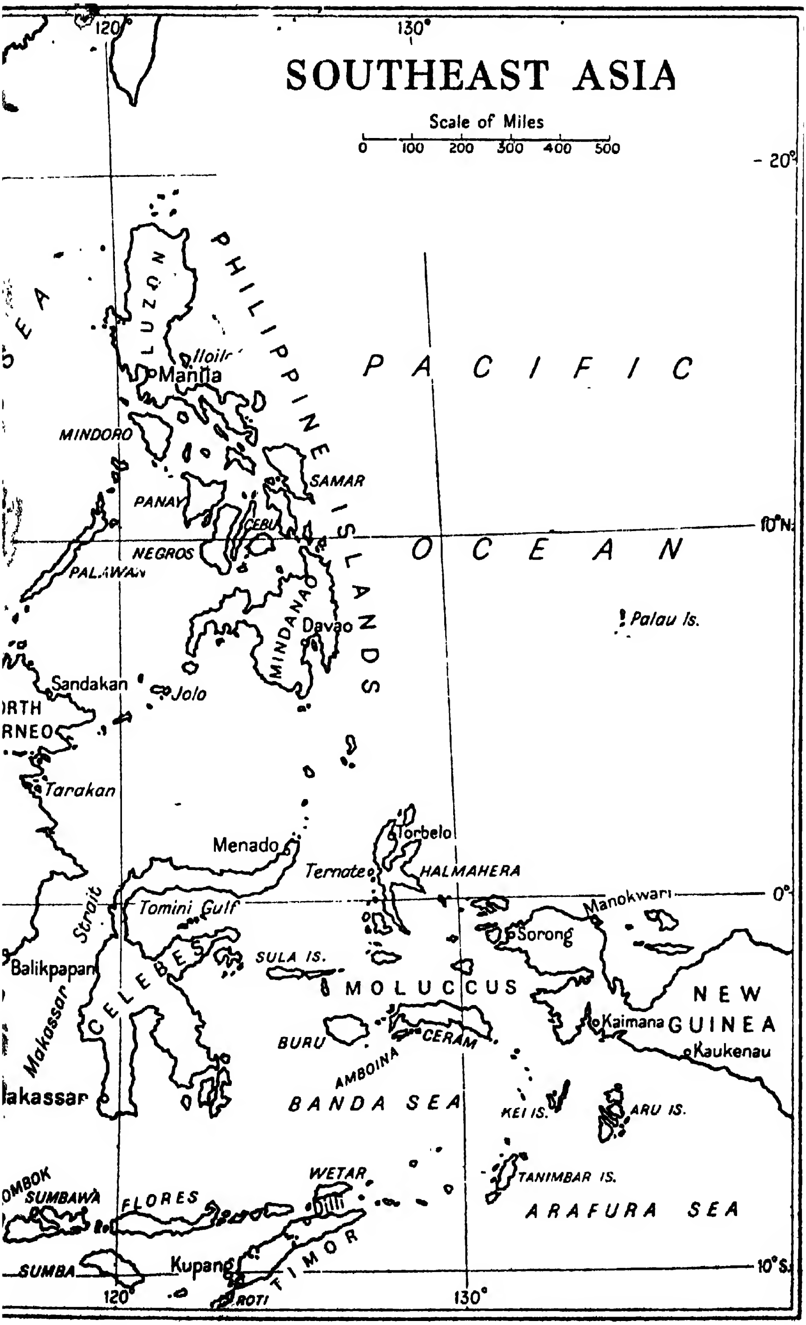
SOUTHEAST ASIA
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PHILIPPINE ISLANDS
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Manila
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MINDANAO
Davao
Sandakan
Jolo
RTH
RNEO
Tarakan
P A C I F I C
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Palau Is.
Menado
Torbelo
Ternate
HALMAHERA
Manokwari
Tomini Gulf
Strait
Sorong
Balikpapan
CELEBES
SULA IS.
MOLUCCUS
NEW
GUINEA
Kaimana
Kaukenau
Makassar
BURU
CERAM
AMBOINA
akassar
BANDA SEA
KEI IS.
ARU IS.
TANIMBAR IS.
WETAR
OMBOK
SUMBAWA
FLORES
Dilli
ARAFURA SEA
SUMBA
Kupang
TIMOR
ROTI

SOUTHEAST ASIA

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PREFACE

THE aim of this book is to present a picture of environmental conditions and human adaptations in Southeast Asia which shall provide the student with a basic text and at the same time stimulate the sociologist, the administrator, the politician and the businessman to see the relation of their work to the general field. It is assumed that readers will already know modern writings on the physical, environmental and social aspects of geography, and the text dwells at length only on those circumstances peculiar to Southeast Asia and its people.

This book is not a dictionary, a gazetteer or an encyclopaedia. It is one of the first studies of locational perspectives in Southeast Asia, the critical importance of which became apparent during the last war when the scarcity of information demonstrated how little study had been given to the region as a whole.

The book is divided into three parts. The first pictures the natural setting, the second goes from this basis into the human details of each political unit, and the third ties together the social geography of Southeast Asia, to pose some of its present problems.

All money references have been converted into Straits dollars (2s. 4d. or U.S. 47 cents) partly because this currency had wide pre-war usage in the region, partly because it is the one with a simple and fixed relation between its post- and pre-war values. The object has been not to overload the text with statistics which are best obtained fresh from the latest year-books. At every stage in reading this book, reference should be made to the topographic maps of Southeast Asia, which now exist in fair quantity.

The author thanks Professor E. G. R. Taylor for her advice on this work and her encouragement at many stages of his career, and Professor L. D. Stamp for his kindness in reading and advising on the manuscript. Those pioneer scholars of the area, whose papers are listed in the bibliography, and upon whose work the author has of necessity drawn liberally for facts, are also thanked. In addition he is heavily indebted to his wife for her continued patience and co-operation at every stage in the production of this book.

If the result of this work is to stimulate a flood of critical studies of Southeast Asia, however much later workers may question its statements, the author will be satisfied, especially if it encourages and helps students living in Southeast Asia to write about their own countries.

E. H. G. Dobby

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PART I

THE NATURAL LANDSCAPE OF SOUTHEAST ASIA

Chapter One

THE NATURAL LANDSCAPE OF SOUTHEAST ASIA

SOUTHEAST ASIA is a term which became popular during the Far Eastern War 1941-45, to describe those territories of Eastern Asia which lie south of the Tropic of Cancer (Burma, Siam, Indochina and Malaya) and the nearby islands spreading eastwards from the Asiatic continent towards New Guinea. The archipelago section merges eastwards into island groups of the West-Central Pacific, for which reason New Guinea itself may best be considered outside the definition "Southeast Asia," an exclusion justified (*a*) by its closer physical association with the Australian Continent, (*b*) by its sparse population of distinctive anthropological type now found principally in Australia, and (*c*) by the close affinities of its flora and fauna with those of Australia. The northern limit of Southeast Asia extends beyond the Tropic of Cancer to include Upper Burma on the western side, and withdraws south of the tropic to the political boundaries of Siam and Indochina farther east. By this definition, "Southeast Asia" and its off-lying islands sprawl asymmetrically across the Equator and cover a zone not far short of 1,500 miles in radius from a point off the mouth of the Mekong, an area comparable to all Europe and its seas north of the African coast. Thus isolation by great distances, as well as by physical obstructions, is a constant factor in the geographical relation between the various parts of Southeast Asia.

In Southeast Asia, that which forms its core and constitutes the geological link between its chief parts is the Sunda Platform, the southernmost continental block of Asia, whose integrity as a land mass has continued, with only minor tectonic disturbances on its fringes, through such long geological periods that it may be compared with those other "permanent" massifs, the Deccan, the Arabian Block and the Laurentian Shield. It is this physical feature which underlies Borneo, Eastern Sumatra, Northern Java and Malaya.

A somewhat similar platform is the common physiographic basis of Australia and New Guinea, forming what is known as the Sahul Shelf, to the east of the East Indian Archipelago.

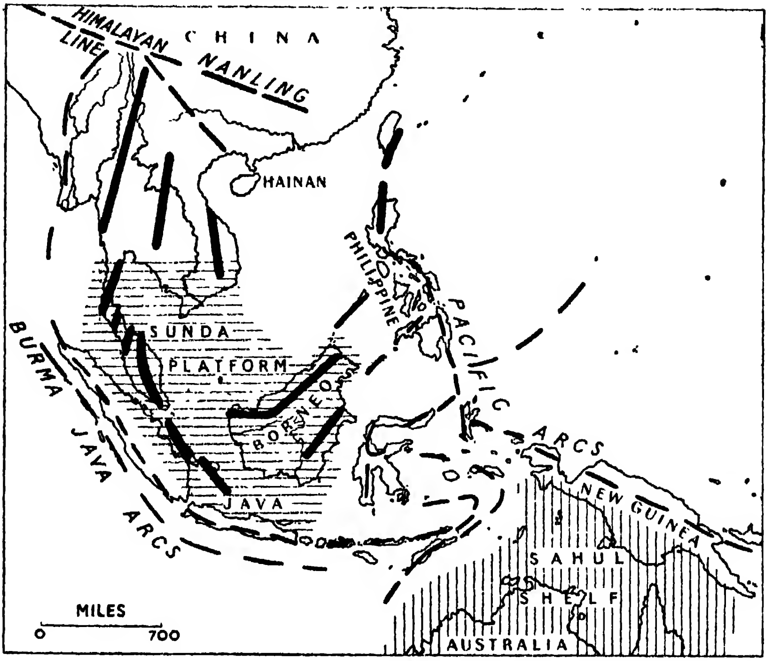

FIG. 1.—Landforms of Southeast Asia

The three basic physical units (Fig. 1) of this region are, then:

1. The Sunda Platform
2. The Sahul Shelf
3. A "ground swell" of young mountain arcs fringing and lying between the two other units.

1. The Sunda Platform

The line of the Himalayan mountain formations extends eastwards to the China Sea to appear in South China as the Nanling and as that line of W-E. mountains forming the watershed between the Red River of Tonkin and the Sikiang of Canton. This chain of fold mountains of Alpine type delimits Southeast Asia geologically from the rest of Asia and is accepted as evidence of mountain building processes related to forces operating from the north.

South of this marginal zone of latitudinal alignments, the structural trends, although varying from place to place, are mainly meridional and modulate the surface of the Sunda Platform itself

on similar lines. These roughly N-S. ranges are described by Suess as the roots of ancient mountains. They are to be thought of as the denuded vestiges of mountain systems, the inner crystalline cores of which stand revealed by prolonged erosion of the sedimentaries within whose folds they were primarily intruded. These stumps of mountains are typically free from precipices and crags, have gentle slopes but are still fairly high because the parent mountains were huge, probably of Himalayan proportions. Today these "Altaid" relief features, apparent in that mountainous

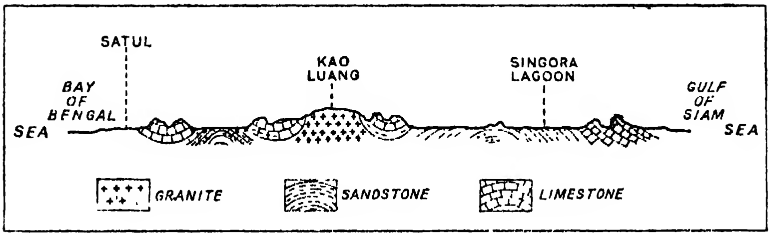

FIG. 2.—A Section of the Kra Isthmus

country between Burma and Siam, in Indochina, in Malaya and in Borneo, by no means approximate to the towering heights of Himalayan and Alpine mountains, having been denuded to little higher than some 10,000 ft.

Towards the centre of the Platform, in Malaya and Borneo, the characteristically senile, denuded relief (Fig. 2) is most emphatic, extending into the islands of the Lingga and Rhio Archipelagoes, which may be considered as monadnocks. The Altaid trend lines, while mainly meridional, are least so in Borneo, where NE-SW. alignments are apparent. In Indochina, Siam and the Kra Isthmus, the N-S. line is well developed and very pronounced in that closely packed series of ranges among which the Irrawaddy, Salween, Menam, Mekong and Red Rivers have parallel courses. While the Sunda Platform has had a prolonged history of stability, at the present moment it is extensively inundated, so that only its higher parts stand above sea level. The advanced peneplainisation of the Platform as a whole is evidenced by the uniformity in depth of the shallow seas, the South China Sea, Malacca Strait and Java Sea, now spread across the continental shelf.

The Sunda Platform is characteristically free from volcanic

phenomena of any except very remote geological periods and it is not subject to earthquakes.

2. The Sahul Shelf

Similar to the Sunda Platform in its morphology, the Sahul Shelf is best considered as a northern extension of the Australian continental mass, partially inundated by the shallow Arafura Sea, and terminating south of the main E-W. range of middle New Guinea. This stable land mass is, like the Sunda Platform, free of recent volcanic forms. Evidence of active mountain building on its fringe, in the north of New Guinea, suggests stresses from the Sahul Shelf towards the north.

3. Young Mountains and Insular Arcs

The festoons of mountains which enfold the Sunda Platform and the Sahul Shelf provide much scope for theories about mountain building processes, a matter outside the immediate field of geography. These mountains in many cases rise steeply from the floor of the Indian and Pacific Oceans to heights over 15,000 feet above sea level; in other localities, the greater part of the mountain system is below sea level and only its topmost points emerge as strings of islands. Fault and fold systems on several lines curve and recurve over one another to make an exceptionally involved pattern, in which certain well marked alignments may be distinguished.

(*a*) The Burma-Java loop starts from the India-Burma border and runs through the Arakan Yoma, disappears for some distance as a topographic feature and then continues as the complicated fold-fault systems of Western Sumatra, South Java and eastwards as a string of islands curving back from the Sahul Shelf through the Kei Islands to Ceram. This series on the Indian Ocean fringe of Southeast Asia is paralleled seaward first by a deep oceanic trough and then by an oceanic ridge showing as the Nias-Mentawei Islands off West Sumatra and as the islandless submarine ridge south of Java.

(*b*) The arcs on the Pacific margins run through the Philippines and Northern New Guinea, creating lines of islands enclosing small, deep, square-shaped, oceanic basins. Troughs or trenches much deeper than the Pacific average are situated on the Pacific side of these arcs (the Philippine Trench is over

7 miles deep), and these resemble in form and location the oceanic trenches off Sumatra and Java.

(*c*) The complex of short arcs and knots showing in the Celebes-Moluccas groups have alignments which repeat the patterns of the Pacific and Indian Ocean fringes, and of the inner edges of the Sunda Platform and the Sahul Shelf. Here, too, the arcs

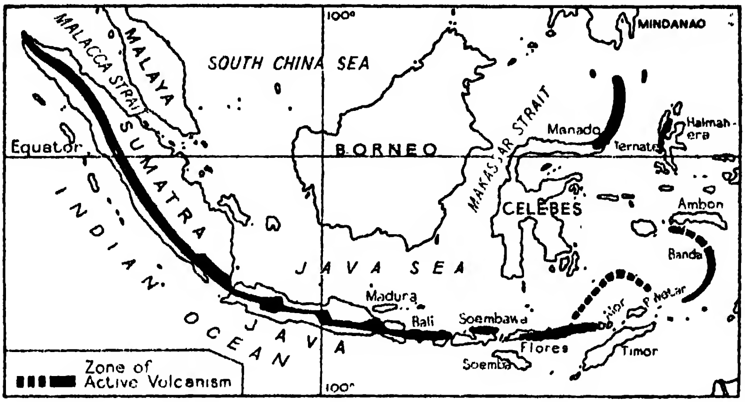

FIG. 3.—East Indies Volcanic Zones

enclose deep geosynclinal oceanic basins, such as the Molucca Sea which is over 16,500 ft. deep. The intersection of these alignments produces the curious shapes of Celebes and Halmahera. This zone may be likened to the "mediterranean seas" between Europe and Africa and between North and South America; in this case it is a mediterranean sea between Asiatic and Australian continental blocks.

Throughout these zones of contemporary crustal deformation, the longitudinal and transverse fractures are dotted with volcanoes, many of which are still active (Fig. 3). Their ejecta further complicate the land forms already made complex by the ravages of violent erosion (Fig. 4). Lava and igneous materials of widely varying ages have flowed over large areas and even on to parts of the Sunda Platform, as in Sumatra. Within the oceanic deeps marginal to these zones of crustal stress are the epicentres of most of those major earthquakes whose frequency is yet another symptom of the instability surrounding the shelves.

Thus the geomorphology of this third zone is transitional,

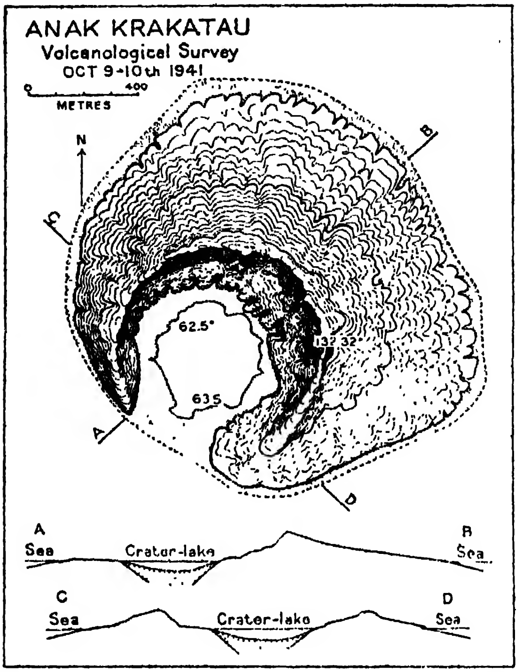

FIG. 4.—Detail of a Volcanic Island in the East Indies

reflecting at once the influence and forms of continental Asia and continental Australia, and of the Indian and Pacific Oceans.

Rock Types

Profound chemical action caused by tropical and equatorial weathering has two effects on most of Southeast Asia; the destruction of readily accessible fossils by weathering and the concealing of native rocks by great thicknesses of weathered material. Thus the historical geology of Southeast Asia, the dating of the rocks, is not yet fully studied, and the geological interpretations of local rocks are by no means unanimous.

So far as their general character is concerned, however, no appreciable difference can be noted between the rocks of Southeast Asia and those of more intensively studied areas in Europe and North America. The effects of each rock type in conditioning landscape forms appear to be much the same throughout the world, differing in degree, not in character.

The pattern of rock types may be summed up thus:

1. Within the Sunda Platform quartzites and shales are prominent over large areas, generally producing subdued relief, not closely allied to the fold lines of the strata. These metamorphics often appear at the surface close to a group of limestone rocks of which a calcareous shale, much of it in areas of low elevation, is most extensive. Massive limestone is most common as a landscape feature where least subject to solution weathering,

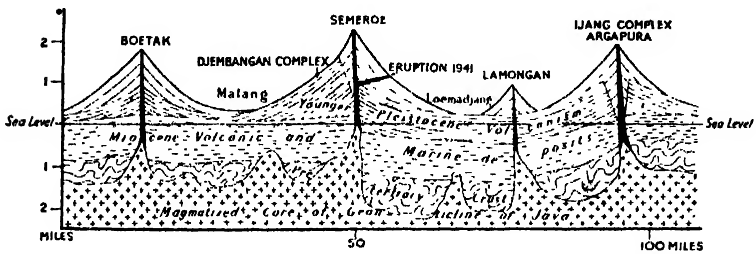

FIG. 5.—Schematic West-East Section of the Mountain Structures in Malang

towards the drier margins of the Platform (as in East Java and Tonkin) where it stands out as gaunt hills whose features recall those of the Karst, though partly disguised by a wilder profusion of vegetation. Small, slightly metamorphosed limestone formations retain this karstic character even under equatorial rains, as in North Malaya where they still rear prominently above the horizon. A large part of Borneo, the biggest single exposure of the Platform, is built of old sandstone, establishing a flat-topped landscape through which ravine-like valleys have been cut. The higher mountains of the Sunda Platform, the Altaids of Suess, are invariably elongated intrusions of igneous rock, mainly granitic, and this material forms the chief heights of a relief otherwise gently modulated.

2. Upon the young mountain systems marginal to the Platform, the landform owes more to recent tectonic activity than to the nature of the constituent rocks, most of which are also represented on the Sunda Platform. Complex fracturing and folding produce on the young mountains a wild steep landscape which here and there encloses fragments of older continental blocks. The vents and caldera of volcanoes (Fig. 5) add their special forms built from looser, easily eroded rock materials of lava

type which have been severely scarred by denudation. Magmatic rocks have flowed extensively from these volcanoes, spreading over a large area and serving to mask relief forms developed upon underlying earlier structures. As a result of these igneous formations throughout the region, contact metamorphosis has taken place on a large scale, which has a major bearing on the frequency of metallic minerals and helps to account for the scarcity of coal formations.

3. The detail of much of the Southeast Asia landscape is conditioned by contemporary river alluviation and coastal sedimentation (as in Eastern Sumatra and South Borneo) whose thickness and profusion relate to the rapidity of tropical erosion on the one hand and to the stability of the continental platform on the other. Relief upon the great alluviated landscapes is slight. In this zone where there is so much coastline in proportion to the land area, marine accumulations of spits, bars and off-shore beaches are both prominent and important in conditioning coastal topography and the location of settlements. Marine loads tend to be heavy in this zone of violent terrestrial erosion and under certain conditions sediment accumulates quickly owing to the speed with which mangrove establishes itself upon any bank or spit which is built up, thereafter further hastening deposition by hindering the free scouring of normal wave action. Marine sedimentation is greater upon the inner coasts of the Sunda Platform and less upon those coasts facing the Indian and Pacific Oceans where the shore profiles are steep and the waves have maximum fetch.

Character of Seas

Three types of seas may be distinguished by the criterion of depth:

1. Shallow seas of the Sunda Platform
2. Shallow seas of the Sahul Shelf
3. The Austro-Asiatic "mediterranean" basins between the Sunda Platform and the Sahul Shelf, and subdivided by island festoons. In this group may be provisionally placed the Sulu Basin, though the South China Basin between the Philippines and the Asiatic mainland may only be included by considerably stretching the "mediterranean" conception.

1. *Sunda Platform Seas*

These seas, the Malacca Strait, the southern portion of the South China Sea, the Sunda Sea and the Java Sea, are remarkable less for their shallowness than for the uniformity of their shallowness, which is mostly about 120 ft. and only in a few places reaches depths exceeding 150 ft. This derives from the long history of peneplainisation of the whole platform prior to its present partial inundation, which has fairly conclusively been shown to be due to eustatic rather than tectonic changes. The small islands (the Rhio, Lingga, Banka and Billiton islands) within these seas are generally of monadnock type and they have granitic cores. Low profiles characterise the adjoining shore lines where broad estuaries carry low topography far inland and where flat coasts of sedimentation, backed by marshes, are more common than those of marine erosion. Such shallow seas are affected strongly by currents arising from winds and less by the circulatory systems of the surrounding oceans, so that monsoonal wind reversals are the major influences on water movement. The drift of surface water thus relates closely to the wind systems described in Chapter 2. Out of contact with oceanic circulations by reason of the disposition of islands athwart the lines of Indian and Pacific Ocean water movements, and located between equatorial land-masses with a very heavy rainfall draining into them, these shallow seas are abnormally fresh and remain abnormally warm: from salinities of 31 per mille and sea temperatures of 70° F., few parts of the surface waters show any significant deviation from place to place or from season to season.

Enclosed between the Andamans, Burma, Kra and Sumatra is a sea steadily being encroached upon by the Irrawaddy Delta, yet its depth and connection with oceanic circulations external to the Platform relate it chiefly to the Bay of Bengal, except that the huge outpouring from Burmese rivers lowers its surface salinity to figures even below those of the Platform seas.

Further evidence that the existence of these seas derives from eustatic rather than tectonic changes is found in the loose gravels, sands and muds which form most of the beds of Sunda Platform waters and in the absence of raised wave-cut terraces along the coasts. Attached plants may be found almost everywhere on the sea floor, which is entirely eulittoral in character.

2. *The Sahul Shelf*

The Arafura Sea and its extension to the Gulf of Carpentaria have been only sketchily studied and are properly outside Southeast Asia. They broadly repeat the features of the Sunda Platform seas except that the salinities are not so abnormally low because the freshwater inflow is less abundant, since the Australian margin has a lower rainfall.

3. *The "mediterranean seas" of the Indies*

The Snellius Expedition catalogued twenty-six distinct basins and trenches in the 'mediterranean seas' of the Indies, excluding the deep between the Philippines and China which scarcely belongs to the region. Of these, eight are deeper than 15,000 feet while the sills between them are not less than 4,000 feet deep. Within each basin there tend to be two circulatory systems:

(*a*) the surface circulation, relatively fast-moving, connected freely with circulations in adjoining basins and thence with currents in the open ocean. It is confined to an upper layer reaching from the surface to approximately the depth of the sill surrounding the basin, that is, to an average depth of about 5,500 feet. The location of the main island barriers is such that the upper waters are strongly influenced by water from the North Equatorial Current of the Pacific, which presses into the 'mediterranean seas', through those many gaps between Mindanao and New Guinea, Scarcely any similar currents derive from the Indian Ocean, in the direction of which the basins are almost isolated by the continuous Sumatra-Java obstruction. In temperature, these basins have a surface warmth similar to that of all equatorial waters, the great difference between their surfaces and those of the Platform seas being a higher salinity—generally 34.5 per mille—and a diminished influence of monsoon winds.

(*b*) the circulation at depth, a movement so slow that the expression "creep" might be substituted. This movement takes place within each basin or trough, isolated from circulation in neighbouring deeps by the sill, and from the surface movements by a discontinuity plane which develops owing to the greater density of the deep water. For the most part, however, the water moving in these isolated deeps originates from the

Pacific by creeping into the Northern Banda Basin, then passing through the Southern Banda Basin and the Weber Deep, the Sawoi Basin and the Weker Basin out into the Indian Ocean deeps. All these lower waters have characteristically high salinity and low temperatures, which prevent any continued outward movement from the basins, though there is a steady removal of water drawn in from deep-level Pacific Equatorial water, whose feature is low temperature by comparison with adjoining water at the same depths within the sills. Inside the basins, minimum temperatures are found just below the level of the lowest sill. Farther down this temperature increases adiabatically but the potential temperature (i.e. reduced to sea level) remains low, so that no convectional circulation is induced. Under these conditions of dense water stably stratified, the profound deeps tend to accumulate hydrogen sulphide.

The margins of these 'mediterranean seas' commonly show raised beaches and wave-cut terraces uncorrelating in altitude from point to point owing to the wide variation of amplitude in the tectonic changes over short distances. Shore profiles are normally steep with the result that estuarial sedimentation is negligible.

Tides

Within these partially enclosed seas, the greatest tidal impulse comes from the Pacific, towards which broad openings are presented on either side of the Philippines. Only in the Gulf of Rangoon and in the funnel-shaped Malacca Strait do tidal forces from the Indian Ocean operate, though they do slightly filter through the gaps in the Lesser Sundas, the line of small islands between Java and New Guinea.

Tides in the deep basins and troughs of the mediterranean sector have not been studied in detail. They probably function as standing oscillations, whose periodicity depends on the form and size of the deeps.

Conditions on the Sunda Platform are better known because of their greater importance to international navigation. The tidal impulse comes to the shallow seas mainly from the east and whatever the character of tides in the open ocean or in the mediterranean basins, the impulse is converted into progressive waves by the shallowness of the seas upon the Platform (Fig. 6).

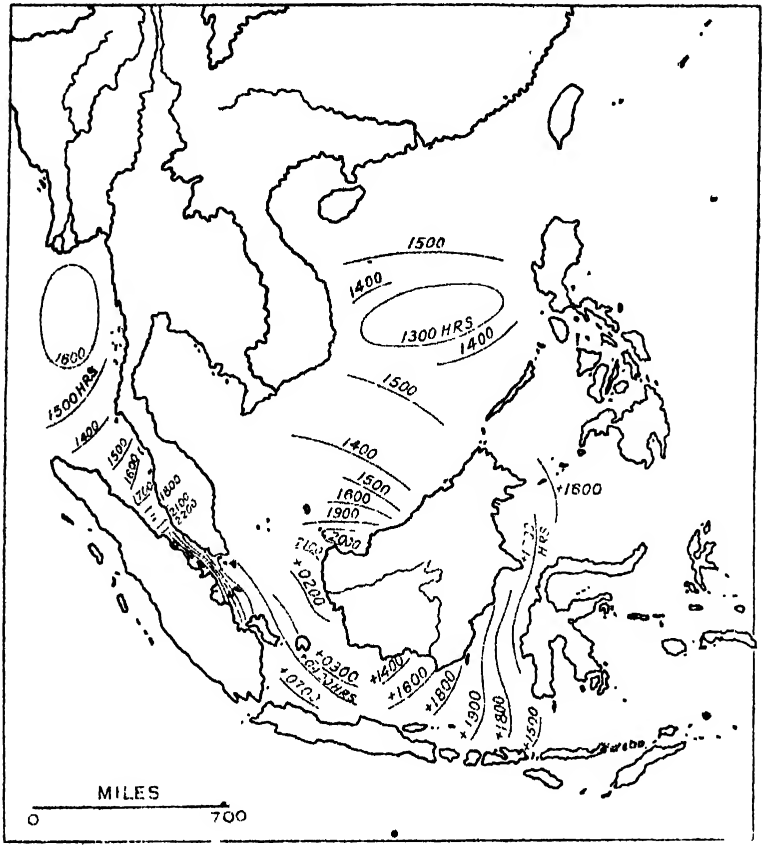

FIG. 6.—Co-tidal Lines in Southeast Asia seas for 15th March 1947

From the west, tides from the Gulf of Rangoon Deep move down the funnel-shaped Malacca Strait, travelling somewhat faster on the Malayan side than on the Sumatran, and steadily increasing in range. From the east, there is firstly the tide from the Hongkong Basin, which is of Pacific origin, and secondly the tide in the Java Sea deriving from the southernmost 'mediterranean seas', which take their main impulse from Indian Ocean tidal movements, operating in the Timor Sea and through the Lesser Sundas. The South China Sea tide moves south through the Sunda Sea and travels through the Java Sea along the southern coast of Borneo, whereas the Northern Java coast is for some distance subject to a tidal movement from the east.

Just west of Singapore Island, the Malacca Strait and the South China Sea tides converge, locally retarding the scouring capacity and apparently favouring heavy marine sedimentation derived from the adjoining land masses. Among the Lingga and Rhio Islands, the actual tidal movements are extremely complicated due to convergent tidal waves from neighbouring seas. Tidal values in all these seas are modified seasonally by winds which practically reverse through the year, working to augment or reduce the tides as the case may be. The South China Seas, whose length parallels the direction of the seasonal wind streams, is particularly subject to this modification in the Northeast Monsoon which very much affects the ease of tidal progression from that sea into the Java Sea.

Corals

The polyps and other organisms whose skeletons accumulate to form coral reefs, live in colonies which within four years may grow to two inches in diameter from a single individual. They are exacting in their environmental requirements, needing sea temperatures of at least 58° F. throughout the year, shallow clear water to permit their food processes, which are largely photosynthetic, and fairly high salinity. A live coral colony has a slimy surface which is in fact the living matter; the live cells die if exposed to the air, or if covered with mud. Corals establish themselves for the most part on rocky foundations. Off Southeast Asia distinct differences can be seen in their regional distribution.

On the Sunda Platform as a whole corals are only developed well beyond easy access from the shore. The relatively fresh seas with swampy margins heavily charged with fine silts and humic acids are unfavourable to the polyps and the recent history of slow inundation of the Platform operates against them as well, though corals are found at depth along its margins and in broad belts round the rocky islands off South Malaya. Platform corals are exclusively submarine and generally stand below sea level well offshore, so that they are never prominent on a coastal landscape. The great development of coral is on the eastern edge of the Platform, running parallel to the east coast of Borneo and well out into the Macassar Strait (Fig. 7), where broad reefs occur whose proportions resemble those of the Great Barrier Reef on the eastern edge of the Sahul Shelf. These locations are favourable because they are washed by the warm onshore equatorial currents;

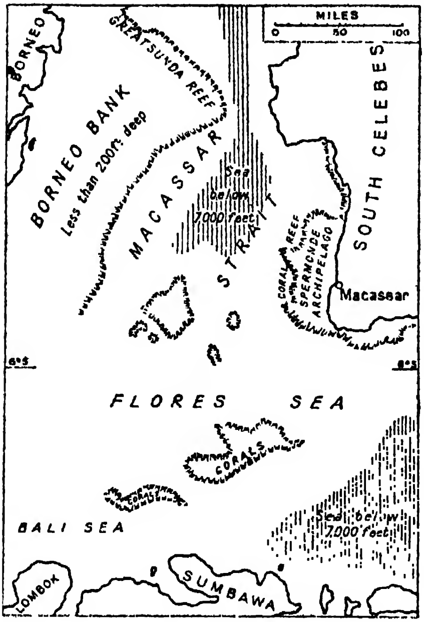

FIG. 7.—The Borneo Bank and the Great Sunda Barrier Reef on the East of the Sunda Platform

similar extensive developments on the western side of the continental shelf are prevented by slight upwellings of water produced behind offshore currents.

Within the 'mediterranean seas', the occurrences of coral are less extensive at any one point but they show much greater variety of form. Atolls, barriers and reefcaps at varying levels above, below and inclined to present sea levels and in varying degrees of symmetry to existing islands, may be found in this zone where there has been steady and repeated displacement of the geanticlines which form the chains of islands.

Several theories have been devised to account for the formation of coral. All of them start from the environmental requirements of the live polyp, which is eulittoral, and go on to account for the shape and extent of the accumulations of skeletons by some change of water level. In the Southeast Asia seas may be found examples to support those coral formation theories stressing sea level or eustatic change, a dominant process on the Sunda Platform, and also examples of corals associated with secular changes of the earth's crust, the chief physical factor operating among islands of the 'mediterranean seas' and the basis of theories attributing coral formations to submarine tectonic changes.

Chapter Two

CLIMATIC FACTORS IN SOUTHEAST ASIA

FEW regions comparable in size to Southeast Asia have so uniform a temperature régime over the whole area and throughout the year. Apart from those local variations due to altitude, and in Northern Burma and Siam to continental influences from Tibet, Southeast Asia from Lower Burma to Cochinchina and New Guinea has average monthly temperatures which remain within ten degrees or so of 80° F. at all seasons. Symmetry about the Equator and a set of land units thoroughly broken up by water bodies of greater area than themselves account for this uniformity of warmth in time and from place to place, and in turn mean that the broad human and vegetation variations do not correlate closely with variations of warmth from place to place, nor is the rhythm of vegetation and cultivation in the region as a whole set by an annual procession of temperature changes.

The basic rhythm of plants and agriculture through most of Southeast Asia is dominated by rainfall—by its incidence rather than by its volume, though considerable differences in volume make distinct climatic sub-divisions away from the axis of the Equator. Köppen's classification emphasises these climatic differences. In this broken terrain, the pattern of the rainfall and the pattern of its variations within short distances, are set by the wind systems. To understand these is to see the operative factor behind the local differences in rainfall periodicity which very much depend on the aspect of the land masses in relation to the seasonal air currents and to local water areas.

THE WIND RÉGIME

Two similar air masses move across Southeast Asia:

(*a*) The Northern Tropical Air Mass which normally moves from the Tropic of Cancer towards the Equator as the Northeast Trades;

(*b*) The Southern Tropical Air Mass, originating over the Tropic of Capricorn and normally moving towards the Equator as the

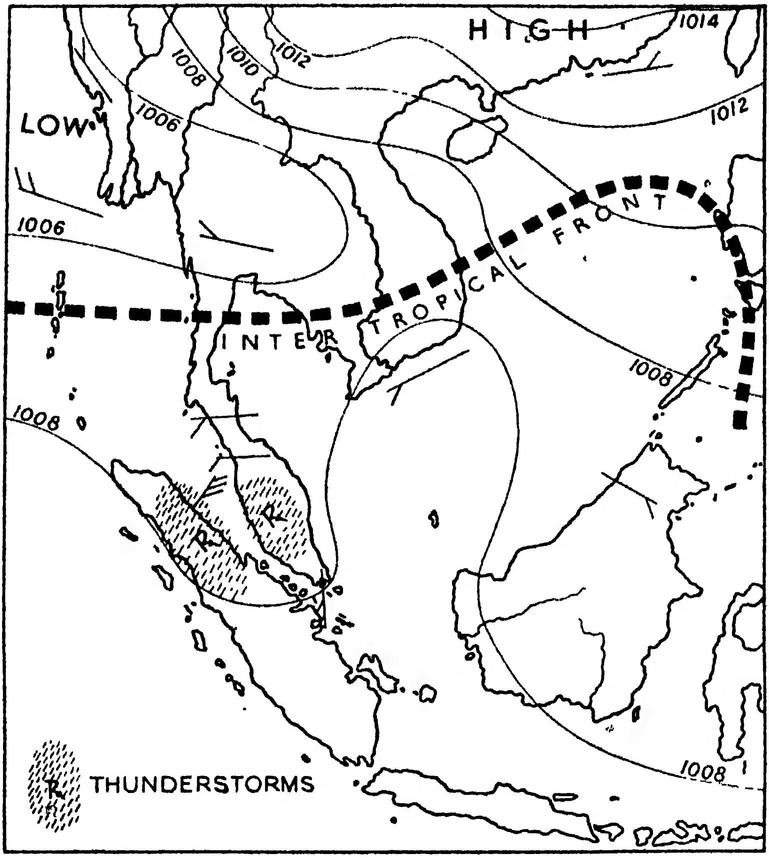

FIG. 8.—Daily Weather Chart of Southeast Asia with isobars in millibars at 12.00 on 28th September 1946

Southeast Trades.

The physical character of the air is much the same in these two masses, which each have long courses across extensive warm seas, so that each is uniformly warm and uniformly damp. Furthermore, the air masses are both losing impetus as they move into lower latitudes. Where the Northern and Southern Tropical Air Masses converge is thus a front, by analogy with conceptions regarding air convergences worked out in other parts of the world, e.g. the Polar Front. The surface of convergence of the two tropical air-streams may be called "The Intertropical Front" and it shows on the weather map as a line.

The similarity of physical conditions in these airstreams means that the Intertropical Front is less sharply defined at any one time by comparison with the Polar Front which separates air masses in different physical states. The warmth, the humidity and the loss of horizontal impulse in each of the Tropical Air Masses mean that vertical impetuses are increasing so that the Intertropical Front is marked by upward movements on both sides, tending to a vigorous convectional action. This explains the frequent calms along the Intertropical Front when strongly developed in what may be called its "ideal position," i.e. roughly along the Equator. In the older terminology, the zone of convergence of the Trade Winds was called the Doldrums. Just as the Polar Front has been found extremely useful in forecasting depressions in more northern latitudes, so also the Intertropical Front is a valuable line for forecasting weather, since along it move mild depressions and squalls which may assume great violence. Daily weather charts (synoptic charts) in this zone have so far only been prepared for official use and are not sold publicly (Fig. 8).

This relatively simple pattern is complicated by two other influences. Firstly, the two air masses are displaced across the Equator by the annual migration of the sun. The Intertropical Front is thus pulled south during the Southern Hemisphere summer and north of the Equator during northern summer. When the airstreams cross the Equator, Ferrell's Law operates upon them differentially so that Southeast Trades moving into the Northern Hemisphere become southwesterly winds and Northeast Trades become northwesterly winds when moving into the Southern Hemisphere.

Secondly, the low pressure areas developed over the continents to which Southeast Asia is marginal, induce certain seasonal deviations in the air streams. Summer low pressures over Australia are just strong enough for the Intertropical Front to be pressed abnormally far south over Northern Australia in December. But the summer low pressures over India and the margins of continental Asia, particularly over Central Burma and Central Siam, have more dramatic effect: the Northern India low pressure system draws parts of the South Tropical Air Mass over the Equator in late northern spring, to maintain a parabolic path over the North Indian Ocean until November. The low pressure system which becomes established over the eastern parts of Asia two or three

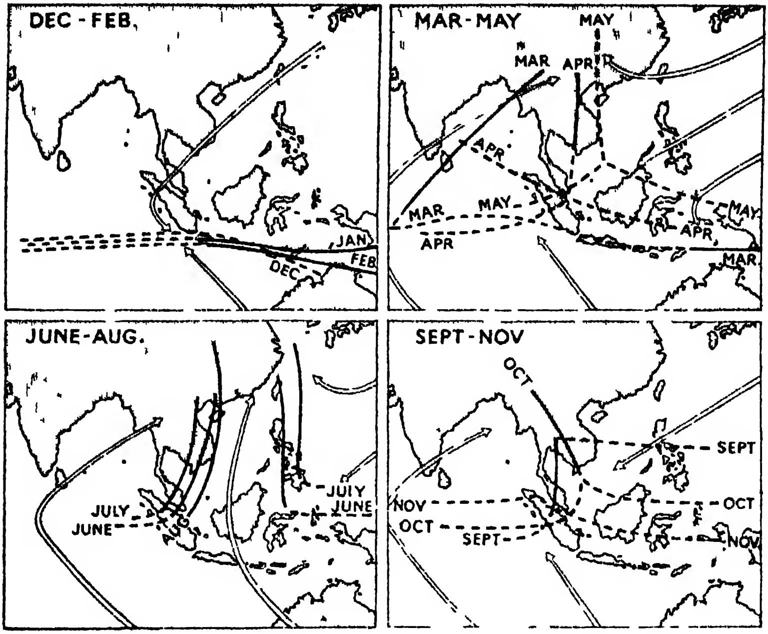

FIG. 9—The Intertropical Front in Southeast Asia. The front is shown by a heavy line, drawn as continuous where it is sharply defined and persistently located; as an interrupted line where the front is weakly defined and subject to considerable variation in position. The open lines show diagrammatically the manner in which the air masses move

months later than that over India, has a somewhat similar effect, drawing Southern Tropical Air far northwards through the South China Sea during June-July-August.

These influences produce the air streaming analysed in the accompanying four maps (Fig. 9), each representing conditions over three-month periods, which may be summarised thus:

1. December to February. The Southern and Northern Tropical Air Masses at this period move almost on ideal lines. The northern air streams cross the Equator as northwest winds reaching to about 7° S. where the Intertropical Front runs almost latitudinally except for a sag farther south towards the Australian low pressure zone.
2. March to May. Three air streams interact at this time. The Southern Tropical Air presses northward but does not substantially cross the Equator near Southeast Asia. The Northern Tropical Air Masses withdraw towards the northeast and in

places move towards East Asia as east winds. Over mid-Indian Ocean, a first part of the Southern Tropical Air Mass (under the influence of Indian low pressures) crosses the Equator to blow across the Bay of Bengal as southwest winds, reaching farther eastwards as the season advances. The Intertropical Front at this time has branched form; its trace becomes roughly a cuspate curve pointing northward and prolonged in that direction by one or two arms which mark the convergences of air streams from the Bay of Bengal and from the West Pacific. The crux of this front is over the Central Indian Ocean in March, moving to positions eastward and slightly northward to one off Labuan in May.

. June to August. Southern Tropical Air increases its migration north and a second major transfer of it into the Northern Hemisphere takes place, driving through the Java Sea and the South China Sea, drawn far northwards by East-Central Asia low pressures. At this time Northern Tropical Air does not reach Southeast Asia. The Intertropical Front opens into two almost symmetrical fronts of hyperbolic shape as a result of the second streaming of South Tropical Air. The double arms of the Fronts are close together at first but the distance between them increases until during August only the western portion lies over Southeast Asia as a roughly N-S. curving front off the coast of Indochina. The Intertropical Front persists over the Malaya-Indochina area throughout this quarter, delimiting two air streams both of which are Southern Tropical in origin yet which have acquired different physical characteristics and directions by taking different courses.

September-November. At this season the Northern Tropical Air rapidly increases its pressure from the north, extending its coverage westward and southward. Southern Tropical Air continues to cross the Equator over the Indian Ocean but diminishes in drive, to cease as an air transfer by November. The streaming of Southern Tropical Air through the South China Sea becomes completely occluded and is finally confined below the Equator as the Southeast Trades. Moving southward, the Intertropical Front reverts to the cuspate form of March-May, flattening to a latitudinal alignment. At this transitional period the cuspate curve is much sharper at its beak and less symmetrical than in the spring.

In considering this analysis of tropical air masses, it must be remembered that the Intertropical Front varies in its preciseness and the positions given here are tendencies often disguised in practice by broad zones of calms. Thus the Doldrums should be considered as the zone within which is located the Intertropical Front, characterised by highly unstable air conditions and traversed by weak depressions moving sometimes westwards, sometimes eastwards, or at certain seasons polewards under the influence of the adjoining continents.

RAINFALL

In Fig. 10 the generalised effect of aspect, relief and these air streams may be seen to produce a rainfall above 80 in. per annum upon most territories of Southeast Asia. The zones of low rainfall are the dry belt of Upper Burma and South-Central Siam which are shielded by relief barriers athwart the air streams. Moreover the total precipitation lessens eastward in the East Indian areas, particularly in the territories and islands east of Central Java.

North of a line from Achin through North Malaya to Mindanao, and east and south of Central Java, very distinct dry seasons appear, the criterion being that of Köppen: at least one month of these areas has less than 2.4 in. of rain. The disposition of these dry zone areas is related to latitudes beyond the equatorial belt and towards the tropical limits. Towards the Equator, precipitation varies seasonally, generally with double wet seasons, though no season is sufficiently rainless to be called dry.

The tropical air masses operating over Southeast Asia are characterised by high temperatures and humidity, coupled with a physical instability which is greatest towards the Equator and decreases towards the continent of Asia. As a result of this instability, relatively weak depressions, small relief features and local overheating by insolation in, say, a town or in bare fields, can act as triggers to stimulate violent vertical air movements. Altitude thus has greater effects proportionally than is normal in other latitudes. Under these conditions cumulo-nimbus clouds of as much as 10,000 ft. depth may develop within half an hour and vertical air currents of 100 m.p.h. inside such clouds are quite common. With the parent air so humid, the precipitation consequent on such updraughts is very heavy (often as much as 2 inches

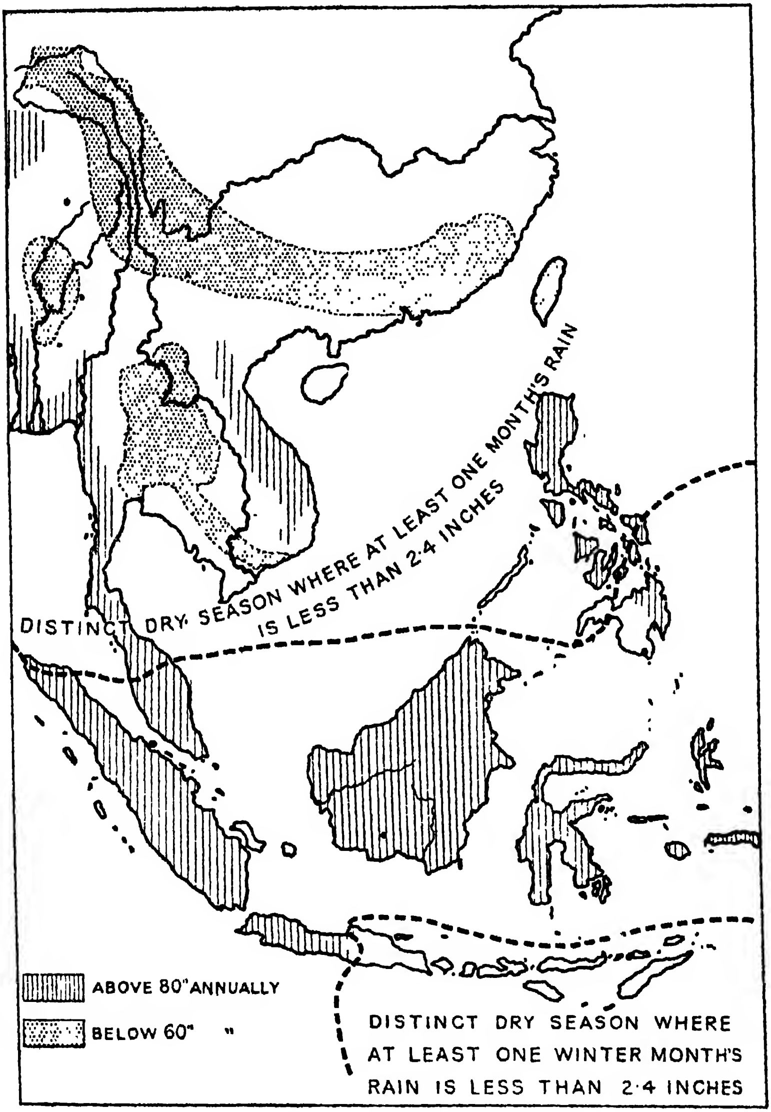

FIG. 10.—Climatic Factors of Southeast Asia

within an hour) even though localised over a small area, and the latent heat deriving from precipitation serves to perpetuate the uprush of air. While all types of initial cause of precipitation occur over Southeast Asia, they tend always to be accompanied by

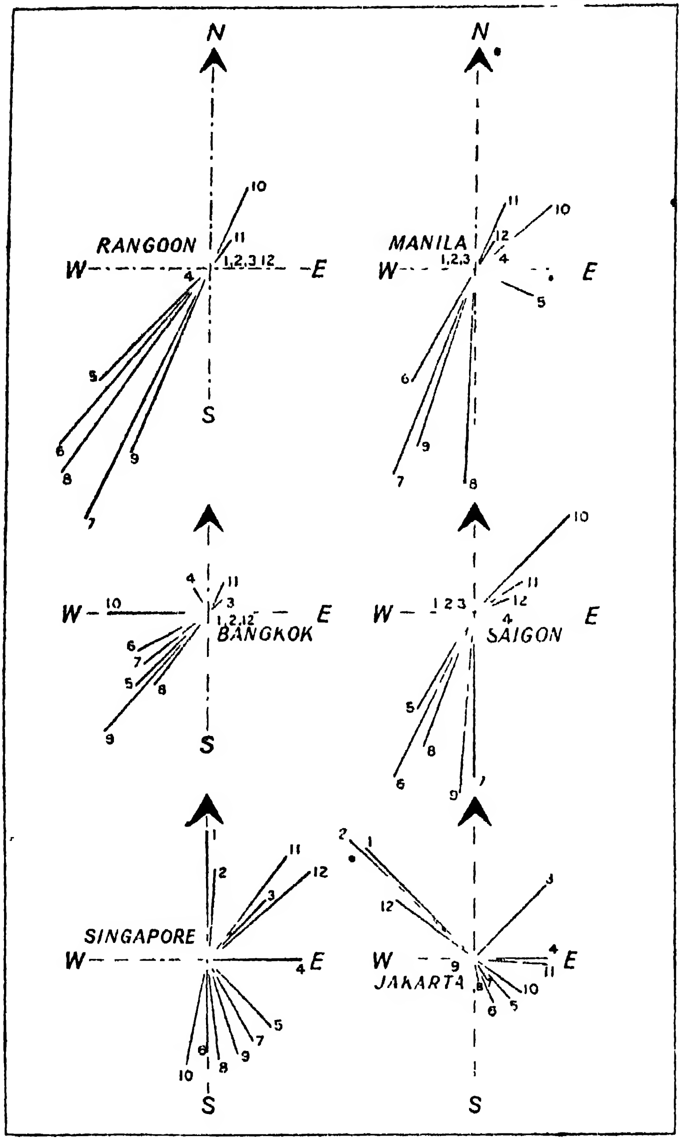

FIG. 11.—Correlation of Rainfall and Wind Direction in Southeast Asia. The bearing of each arm represents the mean monthly direction of the wind (blowing towards the centre) and the length of each is proportional to the mean monthly rainfall. Months of no rainfall are thus no more than points at the compass centre. The numbers on each arm indicate the month (1 Jan., 2 Feb., etc.)

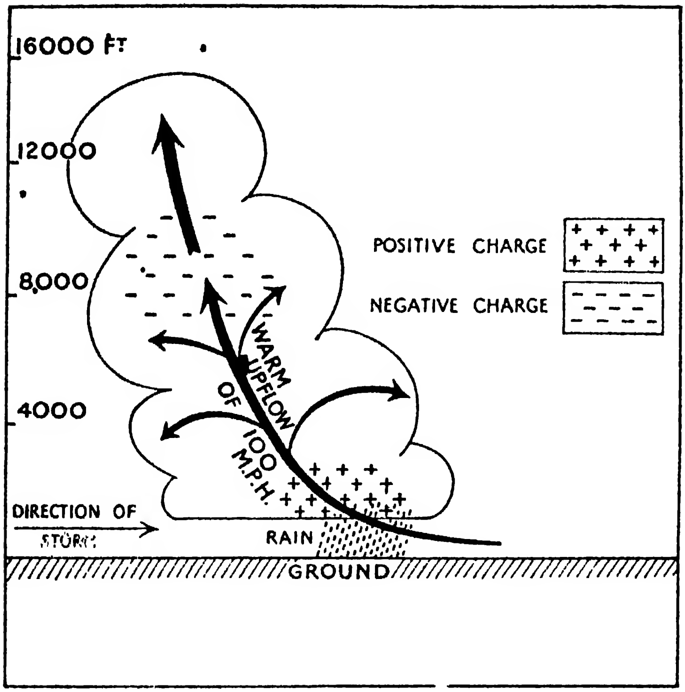

FIG. 12.—Structure of a Tropical Thunderstorm

thunderstorms, which towards the Equator are of daily occurrence and great violence (over 320 storms occur at Buitenzorg each year). Thunderstorm frequency decreases in those sub-regions where winter dry seasons are pronounced, yet even there the rainy months have high thunderstorm frequency. These Southeast Asia thunderstorms resemble those of middle latitudes (Fig. 12) and are accompanied by a "chimney" of rapidly rising air at the core, often with downflows of cooler air just in front of the storm. While the up-current of these thunderstorms is strong enough at times to tear an aeroplane apart, the freezing level is so high (above 25,000 feet) that hail, a common feature of similar storms in other latitudes, is here rare. The degree of correlation between rainfall and wind is evident from the combination of wind-roses and rainfall data in Fig. 11 which also demonstrates how emphatic is the dry season at places away from the Equator.

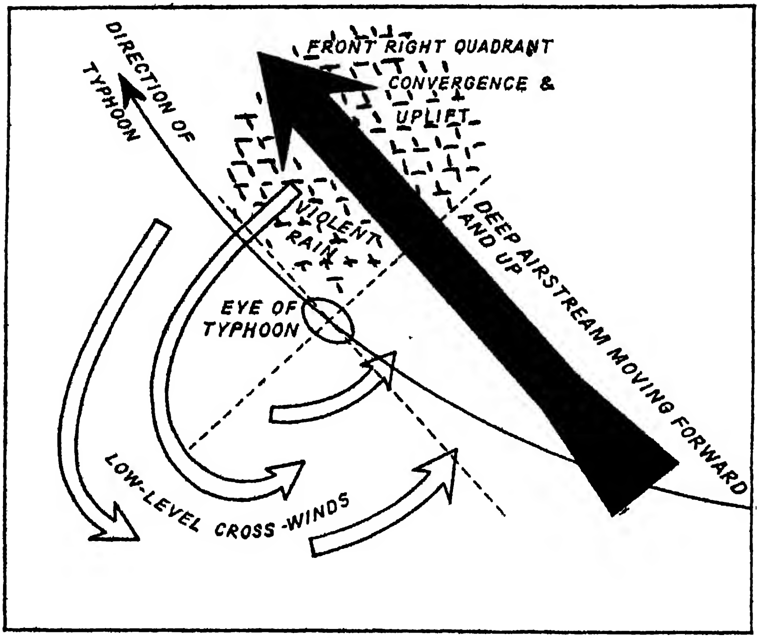

Fig. 13.—Theoretical Structure of a Typhoon

Typhoons

"Typhoon" is the name given to tropical cyclones which occur off East Asia. Only the northernmost parts of Southeast Asia come under the influence of typhoons which are most frequent over the Philippines and Indochina. A few have been known to cross the Kra Isthmus and pass over Bengal. The Bay of Bengal typhoons, frequenting a restricted area well north in the Bay, do not normally affect Burma, so that only the South China Sea typhoons strongly influence the weather conditions of Southeast Asia territories.

While theories about the origin of typhoons do not reach general agreement in detail, partly due to the difficulty of obtaining full meteorological data about these phenomena whose violence so often destroys instruments and whose variable paths defy advance preparation for tests, they seem to result from a widespread convection of hot, moist, unstable air and may represent extreme variants of the forces arising from convergent air currents. Much has been done to accumulate data about sea level features of

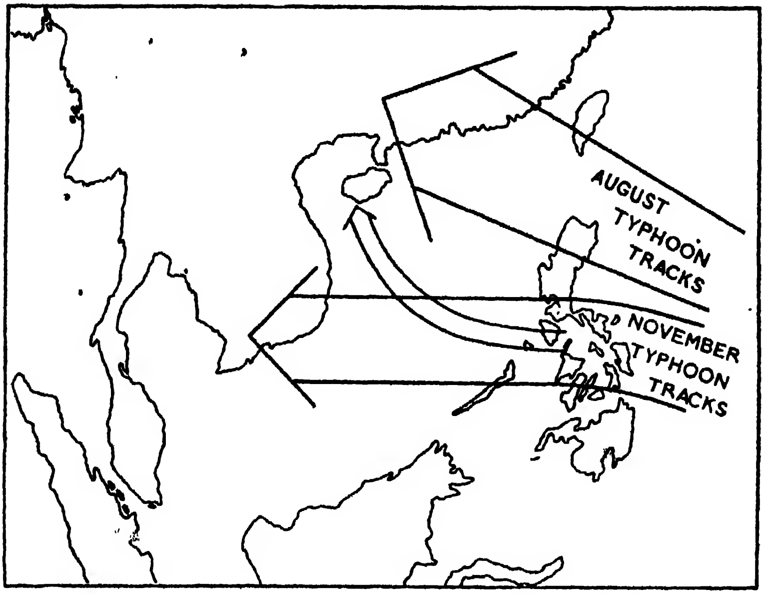

FIG. 14.—Typhoon Tracks in the South China Sea

typhoons, but little information is available about their vertical structure apart from navigators' notes on cloud formation. Clines, writing on the basis of U.S. data, seems to have established that typhoons are in fact largely self-perpetuating from the release of much latent heat due to violent precipitation in the front right quadrant, where he suggests a point above the ground at the precipitation level is in effect a constant generator of heat, and a constant low pressure focus towards which the sea-level barometric centre is always moving (Fig. 13). A close relation between the path of typhoons and a front between air masses has also been suggested.

Typhoons of the South China Sea normally originate somewhere east of the Philippines and travel towards those islands and Indochina, along paths which gradually assume that parabolic line peculiar to all tropical cyclones, so that somewhere between the Philippines and Tonkin they begin to recurve on a line towards the northeast (Fig. 14). The seasonal incidence varies. In the period 1918-29, ninety-eight South China Sea typhoons were distributed thus through the year:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Number of Typhoons	2	0	0	0	4	6	22	17	11	15	15	6	98

The peak periods, July to November, relate to the abnormal positions of the broken Intertropical Front as shown in Fig. 9. Regarding the mean tracks of these East Asia typhoons, it will be noted that they normally move on paths shifting progressively northward from February to August and shifting southwards thereafter until January, but they never reach much farther south than the Cape of Cambodia. From July to September the maximum danger zone for typhoons is north of latitude 15° (Luzon and the Gulf of Tonkin) while in October and November maximum typhoon risk is on the coasts of Cochinchina and the extreme south of Annam.

South China Sea typhoons have characteristics like those of similar disturbances elsewhere. In advance of them whispy cirrus clouds at high altitude and broken cumulus clouds at lower levels drift across the horizon, the latter becoming dark rugged clouds, more numerous and coalescent in the centre as the typhoon approaches. About 100 miles from the centre, dark nimbus clouds develop and produce torrential rains moving forward with the whole typhoon at rates from 10-20 knots, while the constituent winds often increase to speeds reaching and exceeding 80 knots. Each typhoon has an "eye" of comparatively small area, perhaps 5 miles in diameter where the sky is relatively clear, calmer or only lightly squally and no rain falls, resembling an intensified form of the quiet conditions between the warm and cold fronts of a middle latitude cyclone. Behind the "eye" of the typhoon winds again blow with devastating violence, in a reverse direction to winds in advance of the "eye," with nimbo-stratus clouds producing torrential rains which reduce visibility to nil. These gradually lose intensity and the typhoon passes over, leaving a trail of high cirrus.

In these deep tropical depressions, the great force of the winds involved causes widespread damage in built-up and cultivated areas. Their violence and frequency is particularly great in Luzon and they appear to lose violence over Indochina. They form one of the major hazards of shipping in the South China Sea, particularly

for native sailing vessels. Most of the first study of these typhoons was contained in European seamen's handbooks which were chiefly concerned with rule of thumb methods by which ships unlucky enough to be caught in a typhoon could avoid the most dangerous parts of them. The coastal zones of Tonkin and Annam experience severe floods in low-lying areas when the typhoon winds set in certain directions which augment the tides. Typhoon winds can, at their worst, lift trains from their rails and cast steamers several hundred yards inland from the shore.

The French observers, Bruzon and Carton, describe thus a typhoon over Nha Trang and Hon Ba in 1926: "The typhoon appeared first on 2nd November, WNW. of Yap and on the 3rd was 700 km. east of Manila. During the night of 5th-6th November it crossed south of Manila. Over the China Sea, its course changed from west to west-southwest and the typhoon struck the coast of Annam on the 7th. At Nha Trang about 16.00 hours on that day, the wind blew violently from WSW. During the night its violence increased and its course changed through NW. and N. to NNE. Minimum pressure was experienced that night (980 m.b.) but at Hon Ba in the mountains (1,480 m.) pressure went down two hours later to 818 m.b. During that one night pressures dropped about 30 m.b. in the path of the typhoon but after a few hours reverted to normal again. Considerable damage was done to Hon Ba forests, many trees were uprooted and in some places entire groves were destroyed. The typhoon brought torrential rain to the whole Annam coast from Faifoo to Cap Padaran."

Certain line squalls moving eastwards to Malaya at very low latitudes in the Malacca Strait have a violence at times approaching that of typhoons and the squalls are in fact related to disturbances on the Intertropical Front: they are not circular in character, have no "eye," are not extensive or persistent features and they have no connection with true typhoons.

Sunshine

Over most Southeast Asia territories for much of the year, the cloud cover is very heavy and the sunshine period is low. This is most emphatic towards the Equator away from which a season of clear skies and continuous sunny weather occurs. The effective sunshine

is rendered even less by the high humidity which cuts off many actinic wavelengths. In Singapore over half the sunshine day is obscured by clouds; in Jakarta less than 70 per cent of the possible sunshine hours are sunny. A distinct diurnal rhythm of sunshine incidence is characteristic of the Equator; during the mornings, which frequently begin clear and sunny, cumulus clouds steadily increase to a maximum in the afternoon, when convectional influences are at their peak, often producing thunder-showers followed by a clearing of the sky towards sunset. The amount of sunshine received is normally greater at sea level and decreases with altitude. On the other hand, those districts with distinct dry seasons have high sunshine values in the dry periods, often offset on the average by prolonged obliteration of the sun during the rainy season. These factors have considerable agricultural significance.

Humidity

High average humidity values are normal everywhere in Southeast Asia, but they are subject to frequent variations. Coasts are damper than interiors and highlands are damper than plains. Localities with marked dry seasons have periods of low humidity accompanied by high temperatures. In any one place a few hours sunshine rapidly lowers the relative humidity and it is a fact that even in the wettest places, the ground and wet clothes dry out under direct sunshine. Comparatively minor humidity variations have considerable effects on plants, and from the point of view of human beings it is the humidity rather than the temperature which produces feelings of body heat or body cold. When the relative humidity drops a few points, the skin sensation is one of coolness, due to easy evaporation of perspiration. By the same cause, a site exposed to regular breezes feels drier and cooler than the actual humidity or thermometer figures justify. The generalised rainfall and seasons map (Fig. 10) is a convenient guide to the distribution of humidity.

Altitude Effects

Throughout the region altitude is an important factor varying the local weather conditions. While the land masses are relatively small, they are orographically very broken so that (apart from

East Sumatra) no very extensive plains have developed and mountains are visible from most points. Even the highest peak known (Kinabalu, Br. Borneo, 13,681 ft.) lies well below the snow line but those highlands adjoining Yunnan do receive a brush of snow in winter. The average highland is, however, more

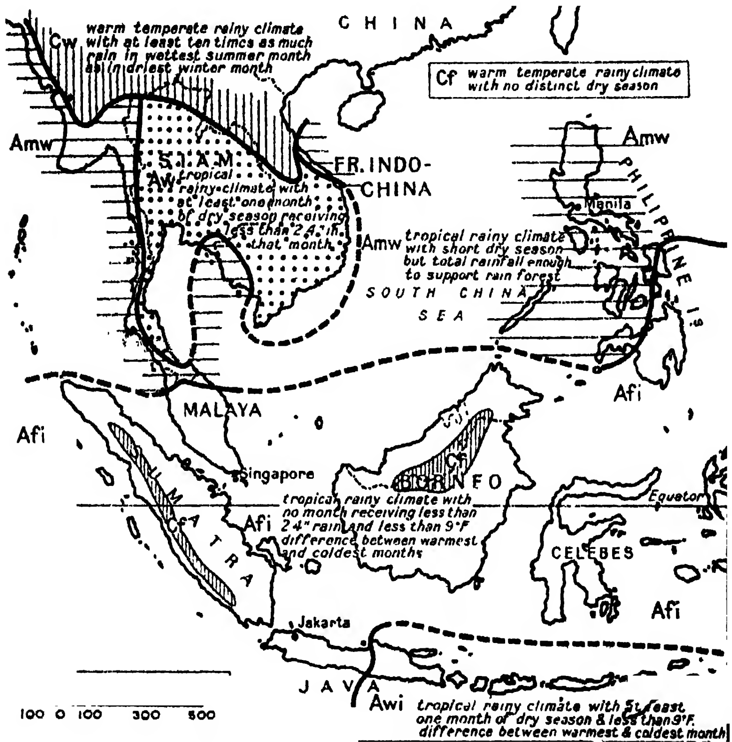

FIG. 15.—Köppen's Climatic Regions in Southeast Asia

of the order 8,000 feet and continuous areas at a high altitude are quite small. These altitudes induce local temperature reduction, more evident at night than during the day, and local high humidities. They cause local rain shadows which, owing to the differing winds through the year, are seasonal rather than permanent, except where double ranges give the intervening lowland a fairly constant rain shadow, as in Central Burma. A major function of the higher altitudes is to cause orographic rains and to lower the temperatures, which latter has less geographical significance than the overall raininess.

Climatic Regions

Raininess is the basic criterion between major parts of this climatic area where temperatures are for most regions never less than warm. Two broad rain types may be distinguished:

(*a*) heavy rains at all times of the year (over 80 inches per annum). In detail there are peaks of raininess, generally double peaks, but between these peaks is a season less rainy, though still without any month which may be called dry. This region is mainly equatorial.

(*b*) rains through most of the year, with at least one month with less than 2.4 inches during these cooler months, the length of dry seasons increasing with latitude and the limits being roughly latitudinal as in Fig. 10. The dry seasons are normally related to wind streams at various times of the year. This zone subdivides into:

1. A subdivision where total rainfall is exceptionally low (below 60 inches per annum) and the drought season long, as in Central Burma and East Siam.
2. A subdivision where the dry season is long and altitude reduces the temperature to less than about 60° for the cool season, but not reaching freezing on the average.

Köppen's classifications for this zone are a convenient but by no means fully checked scheme (Fig. 15).

Chapter Three

THE DRAINAGE PATTERNS OF SOUTHEAST ASIA

THE Irrawaddy, Salween, Menam Chao Praya and Mekong are remarkable for their length compared with most Southeast Asia rivers, which rarely exceed a few hundred miles long. Those four major rivers are associated with tectonic basins; relief elsewhere only permits short streams. All districts marginal to the Sunda Platform have experienced relatively recent tectonic changes and the rivers developed upon them are youthful as well as short. Upon the Platform itself much more advanced landscape maturity is evident but because this older surface has only limited areas exposed; rivers even there are short.

CHARACTERISTICS OF TROPICAL RIVERS

In the régime of tropical rivers several factors have distinctive emphasis compared with conditions in temperate latitude rivers. Firstly the volume of water precipitated into and to be carried from any drainage basin is several times that of equivalent temperate latitude rivers as a result of the much higher rainfall. Moreover the precipitation is more intense. Even the dry interior of Burma experiences falls of rain averaging ·6 inches per rainy day. The water content of those Tropical Air Masses over Southeast Asia is so high and the rising air currents so strong and sustained that several Javanese stations have recorded falls of over 16 inches per day. These violent torrential downpours are often very localised at any one time, yet on an average they affect large areas. Thus the volume of rainwater in any drainage basin is enormous and fluctuates widely within short periods of a few hours.

A further consequence of these great rainstorms is their powerful erosive effects. Upon cultivated land the force and volume of these downpours cause surface downwash to be large, the soil rapidly washes away and whole hillsides may slip, so that the run-off has a high mud content. Because the rivers are mostly immature, this heavy load may be sustained by turbulence for considerable

distances. In areas of alternating wet and dry seasons, drought cracks the ground, loosens the top surface and thereby increases the available load when the rains begin. The Dry Zones of Burma and Siam are for this reason areas of most violent surface removal. The very heavy load of Southeast Asia rivers gives them a great capacity for rapidly building up deltas, sedimenting the estuaries and at times causing heavy deposition of silt well inland. Furthermore the rainfall is not only violent and intense, it is also variable in seasonal incidence; thus many streams of Upper Burma, Central Siam and Eastern Java are for months practically dry and then come into spate within a few hours, not unlike the wadis of North Africa. Landform combined with the seasonal rains causes the Salween, for instance, to vary its level 50 feet within a few hours. Such variability of volume induces deposition well inland. Huge silt banks lie across many watercourses, vast alluvial fans develop at the debouchment to plains, and even at the junction of tributaries.

The Irrawaddy presents an example of how the drainage conditions differ at different points in the course of a tropical river. Near and above Bhamo changes of Irrawaddy level directly parallel changes of rainfall. As the stream passes through the Dry Zone of Burma it receives no significant additional water from the tributaries after it passes the confluence of the Chindwin and it is effectively losing water by evaporation. Stamp estimates 45 per cent of Irrawaddy water has been lost by evaporation when the stream finally reaches the head of the Delta. Evaporation rates in the Burmese Dry Zone are little, if at all, less than the precipitation. Farther downstream, in the Delta, heavy precipitation occurs again, so that the Irrawaddy floods arrive at the Delta roughly a month after peak rains in the reaches above Bhamo, to find it already suffering from floods due to local rains and small local streams. These floods of local origin effectively oblige the Irrawaddy water to remain within the main distributaries. Even more interesting is Stamp's evidence that the average annual silt load at the Delta head is 261 million tons, whereas at Mandalay it is only 32 million tons, showing that 229 million tons of silt is added in the Dry Zone. Since the Chindwin provides 109 million tons of silt, the balance of 120 million tons derives from the wadi-like, highly variable streams (chaungs) joining the Irrawaddy in its driest section.

Load, and the Erosion of Basins

Acting as a brake on the destructiveness of the rivers and on the changes of river levels, the dense forest cover of most of the landscape breaks the force of the downpours and provides roots and undergrowth to act as a spongelike retainer of water and as a partial filter of sediment. Under natural conditions, where the forest is undisturbed by man, this influence is so strong that even minor brooks are relatively clear, but where the natural cover is removed by burning to permit cultivation or mining, the brooks are thick and opaque with sediment, a condition rapidly extending as more and more surface is exposed for farming or for alluvial mining. Wherever there are active volcanoes, great quantities of loose ash are thrown out regularly; Southeast Asia volcanoes typically eject ash rather than lava. Unconsolidated ash without vegetation cover is rapidly washed into the streams and by these agents spread out over the estuaries. A new volcanic outburst is at once followed by heavier loads in the local rivers and increased estuarial deposition (Fig. 19) and greater danger of silting up irrigation and drainage canals which may have been built downstream for cultivating rice. That so much of Java's volcanic ash cones are terraced may only partly be ascribed to agricultural pressure; the terracing is equally necessary to control slip of the ash and to prevent sedimentation by waterborne ash from completely overwhelming the lowlands. Largely as a result of heavy ash loads, the Solo River, for example, carries some sixty times as much sediment as the Rhine, though it has only 40 per cent of its length.

The heavy load being carried away by the rivers lowers the surface of the drainage basin over most of its area, even though part of the lower basin is being built up a little by sediment. The rate of destruction of the drainage basin in the tropics is far higher than anywhere else. The Chindwin is removing the surface of its basin by .78 mm. per annum, the Irrawaddy above Prome by .52 mm. per annum, the Loesi in Java by .87 mm. In some small Javanese streams the destruction of the drainage basin has reached as much as 3 mm. per annum. As standards of comparison, the annual lowering of the Danube basin is at the rate of .006 mm., and of the Marne, .005 mm.

As a region, Southeast Asia is thus one of the least stable in the world, as far as orographic form and drainage patterns are

concerned. Erosion here works faster and the associated deposition occurs at a greater rate than temperate latitude geographers allow for. This adds only a further variant to the general tectonic instability of all the zone fringing the Sunda Platform, but in the case of the Platform itself, its great age and relative stability plus the intensity of river erosion, provide an excellent case of a landscape exposed continuously to subaerial erosion for a period long enough to indicate an approach to the peneplainised state. The Malayan landscape, central to this continental Platform and exposed fully to continuous, powerful and prolonged river action, has special interest in this connection. In Malaya, large alluviated plains dominate the landscape and the hills rise sharply from these plains, yet the features of normal river types still persist. Rapids exist in a number of Malayan rivers, profiles are slightly broken at a number of levels, trellis drainage patterns have persisted on tilted strata (Fig. 32) and river capture goes on even at this advanced stage, as in the capture of the Bera headwaters by the Muar (Fig. 16). Lakes, however, are unusual on the main Sunda Platform; this negative point is at once a symptom of erosional senility and of the ability of tropical vegetation to build out into the lakes, hastening their sedimentation until the standing water disappears. Thus the Bera Lake of Malaya is really a large swamp periodically inundated; the Tonle Sap of Indochina is rapidly filling to become a similar swamp-lake varying with the seasons. Infilled swamp-lakes appear also in Borneo and the Shan Plateau.

The Glacial Period and Southeast Asia Drainage

While tectonic and erosional changes have produced most variations in river forms of those parts of Southeast Asia fringing the Sunda Platform, *upon* the Platform itself, rivers have been more recently affected by a process of marine inundation. There is general agreement that the history of the Platform is one of stability or possibly of slight sinking; the uniform depth and terrigenous bottom material of the Sunda Platform seas, and also the fully-developed river valleys upon their floors, combine to support the view that a rise of sea level has taken place, associated with continental icemelt which took place in northern latitudes when the last Glacial Period closed. De Geer estimates that the last Scandinavian glaciation reached its peak some 25,000 years

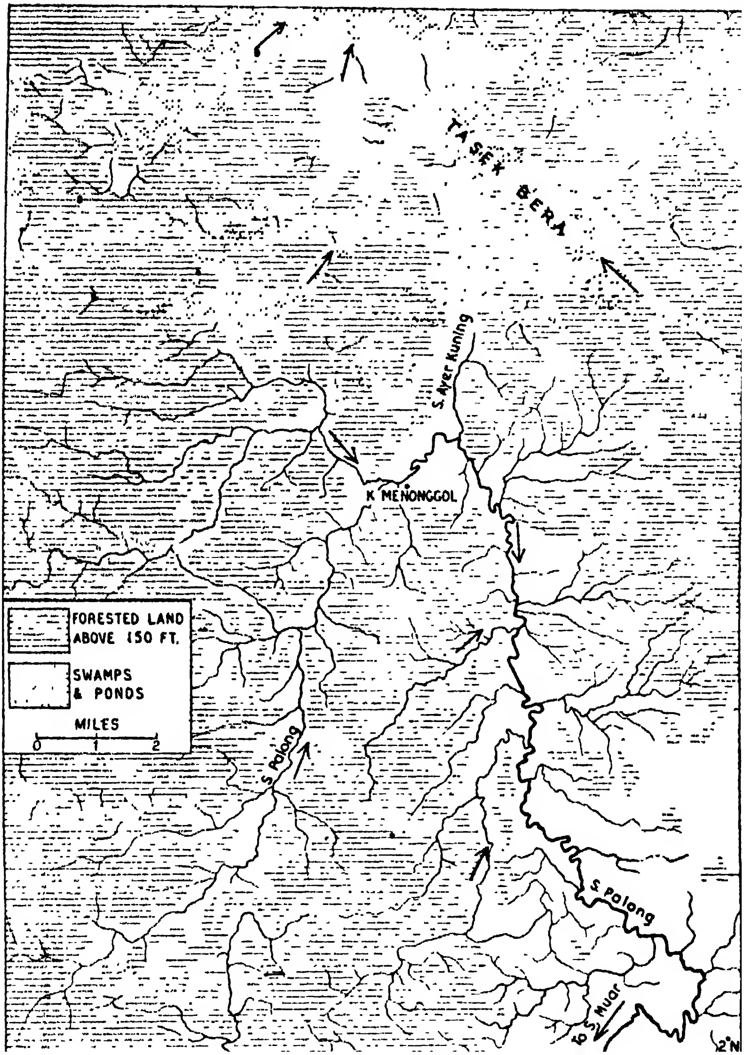

FIG. 16.—River Capture in Central Malaya. The Palong, tributary of the Muar, is drawing off headwaters of the Bera system

ago, at which time maximum water would be withdrawn from oceanic circulation and locked up as ice, thereby lowering the average sea level. Daly calculates that this withdrawal of water would mean a lowering of sea level (relative to present level) at the Equator by between 250 ft. and 300 ft. The average depth of

water in the Sunda Platform seas today is 180 ft., so that on Daly's figures the whole Platform would be exposed and drainage lines developed upon it. Molengraaf's work (Fig. 18) suggests the drainage lines of the exposed Sunda continental surface formed two river systems flowing roughly north-eastwards from the Singapore area and roughly due east through what is now the Java Sea. To support this conception he instances the striking likeness between fish of the Moesi in Sumatra and those of the Kapuas in Borneo and suggests the similarity derives from association through the main stream developed during the Glacial period. Because there have been in fact several glacial advances in northern latitudes (the Gunz, Mindel, Riss and Wurm Glaciation) his theory implies at least four periods of water withdrawal from the Sunda Platform (and of course from all equatorial areas): that is, four periods when the Sunda sea-floors were exposed to subaerial erosion.

Thus the broad history of recent river development has been one of periodical lowering of sea level, in effect a lowering of erosion base levels for all Sunda Platform rivers, which means four intervening periods of rejuvenation of Southeast Asia rivers and corresponding periods of rising sea level when rivers diminished their cutting power and became senescent, owing to rising erosional base level (Fig. 17). While the world glacial periods varied in duration, they appear not to have differed very widely in extent of greatest development, so that present sea level at the Equator probably represents roughly the level towards which the erosional base rose at each interglacial phase. Those early periods of rising sea could not, on present facts, have reached higher than 100 ft. above present sea level and it is almost certain the variation was much less. It is therefore difficult to accept any theorising which postulates during the last million years over the Sunda Platform sea level positions 100 ft. higher than the present one.

The landscapes carved by river systems over the older parts of Southeast Asia are conditioned in their recent forms by circumstances of a rising sea level, quite different from Europe and North America where a relatively rising land surface has had the latest influence on landscape form. A recent history of rising sea level implies:

(*a*) rising base levels to river erosion;

(*b*) diminution of downcutting power by existing streams;

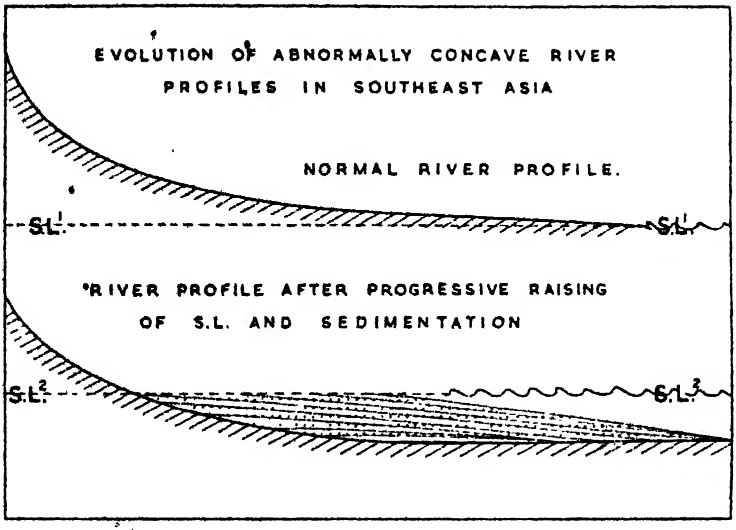

FIG. 17.—Diagram explaining the Development of Inselberge and Concave Profiles typical of the Sunda Platform

(*c*) diminution of load-carrying power and an increase of upstream sedimentation, due to loss of grade in the theoretical profiles;
(*d*) shallow offshore coastal profiles and consequent increase of coastal sedimentation;
(*e*) detrunking of streams as the inundation formed new marine gulfs (see Molengraaf);
(*f*) the rapid sedimentation of the estuaries produces in river profiles an abnormal flattening at lower levels while the upper profile retains the acute forms developed at lower sea level positions. This produces "sagging profiles," concave or flattened outlines (Fig. 17), as contrasted with kinked, faceted and convex profiles of contemporary streams in Europe;
(*g*) mountains in the form of "inselberge," that is, standing like islands surrounded by low-level alluvial plains.

During the glacial periods, when downcutting to a lower base level was the major influence, considerable upstream terraces could develop at all altitudes, but this aspect of Sunda Platform geography is difficult to study owing to the intensive weathering since that time and the heavy vegetation now masking any benches built or carved during the period. Such upstream terraces have been noted by Richardson and Scrivenor in Malaya.

FIG. 18.—Drainage and Shallow Seas of Southeast Asia. Seas now shallower than 200 ft. were probably land areas in the Glacial Periods

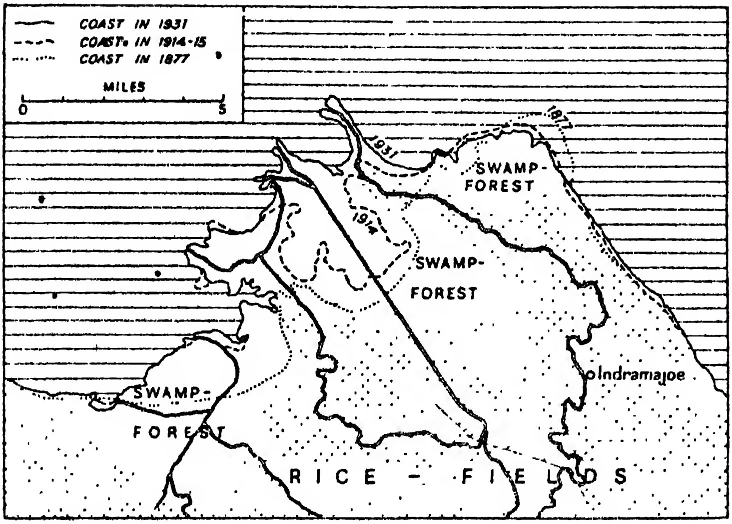

FIG. 19.—Coast Changes at the Mouth of R. Tjimanoek (Hoek van Indramajoe). This shows the rapid changes of the Java coast as a result of sedimentation

The history of inundation at first glance makes it surprising that ria forms have not appeared on the Sunda Platform; the explanation lies in the heavy sedimentation by the rivers and in the relatively soft laterised surface which would be presented to the rising sea and quickly moulded by it.

The glacial periods had little other effect in Southeast Asia; Weissman estimates the snow line in Northern Burma to have descended to about 9,000 ft. during the Glacial Periods. If this lowering of the snow line by about 3,500 ft. compared with today roughly indicates the condition for all Southeast Asia at the time of maximum glaciation, then in the equatorial zone where the present snowline is about 16,000 ft., no mountain tops of Borneo, Java, Sumatra and Malaya could have been seriously affected by snows, let alone by mountain glaciation. Interpretation of land forms in these units on the assumption of glaciation must therefore produce overwhelming evidence to counter such arguments.

SEDIMENTATION

Very heavy river loads, the decreasing carrying power of rivers, and the shallow seas of the Platform zone, combine to make rapid sedimentation of estuarial and coastal regions the characteristic

of contemporary relief forms and drainage patterns. The rate of coastal advance seaward upon the Platform is in places phenomenally rapid; the Tjimanoek (Fig. 19) and Solo deltas in Java are extending at the rate of 100 metres annually, the Mekong at 60–80 metres annually. An outburst of volcanic ash increases the deposition by neighbouring rivers at the coast, though the behaviour of sea currents moulds the riberine deposit in detail on reaching the sea. Mangroves and associated vegetation quickly establish themselves on sandbanks and cays so that at the mouth of the Perak, for example, an exposure of a bank for only a few days at a low water season is enough to permit vegetation to start there, hastening the rate of deposition by offering an obstruction to river outflow and thereby perpetuating the bank which in other settings might disappear by erosion during the next high water spell.

Where streams debouch into deep seas the rate of coastal extension is inevitably less, due to the greater thicknesses which must be laid for every outward extension, yet the Irrawaddy Delta is building outward at the rate of about 60 metres per annum; that the Irrawaddy can maintain this rate of building into a deep basin reflects its tremendous load and a physical condition which concentrates the deposition of this load at the outer edge of the Delta rather than over its surface. (See Chapter 9.)

Because the rivers are steadily sedimenting the bed of their lower reaches, these are in fact generally being raised in level. Such a process cannot continue very far; when its bed is raised slightly above the surrounding land, the river easily changes course, and every large delta of Southeast Asia shows signs of frequent migration of distributaries. Old channels and distributaries in various phases of abandonment may be seen at nearly every river mouth. Most deltas suffer regular inundation at various times of the year facilitating farming for rice, which depends on either natural or artificially induced floods, in most cases derived from rivers. The process of spreading sediment over the whole delta zone goes on both by migration of distributaries and by seasonal inundations, so that the deltaic surface over a wide area is being slowly raised by sedimentation, making it progressively more difficult to irrigate the inner and higher sections of the deltas and in the long run causing the centre of gravity of irrigation steadily to move

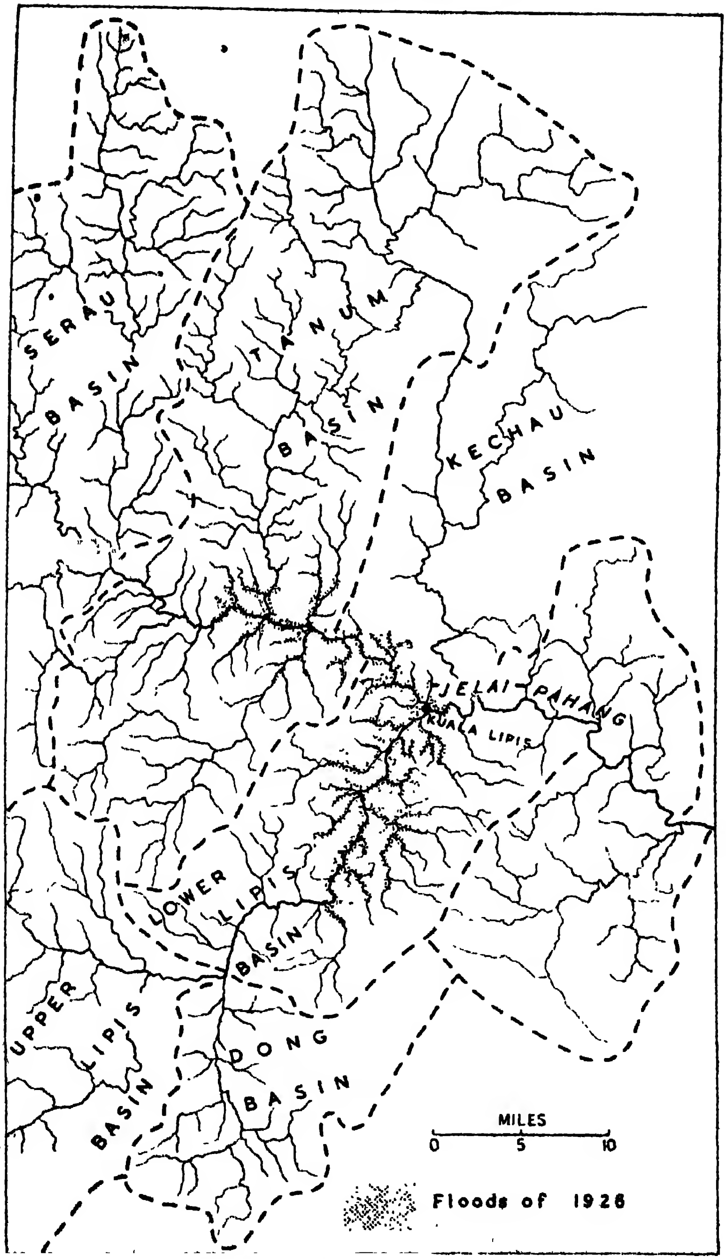

FIG. 20.—Flood Zones at the Junction of the Lipis-Pahang Rivers

downstream, where also the newer unexhausted soils are to be found.

Marshes and Swamps

All land masses whose rivers empty on to the Sunda Platform are thus characteristically fringed with flat landscapes of marshes on a large scale. East Sumatra is an outstanding example of prolonged sedimentation by tropical rivers moving into shallow seas; this coastal marsh, at least 60,000 square miles in area, about a third of Sumatra, indicates what may result from equatorial sedimentation, here probably aided by a volcanic outburst in inner Sumatra during historic time (possibly during the century or so prior to A.D. 1000) and facilitated by the shallow Malacca Strait where the main tidal scour is to the east rather than to the Sumatra side. Huge flat islands have been formed off East Sumatra and they are regularly inundated by tides even now, so that they are in effect amphibious areas. The speed with which these coasts of sedimentation can advance and change should be taken into account when attempting to correlate historic place-names with sites and settlements of today. It may be that the decline of large principalities in Eastern Sumatra, reported in the first millennium by Oriental travellers, should be attributed to changes of coastline and to rapid deterioration of old site values.

Floods

A further feature of old drainage forms in Southeast Asia is the large size of inland swamps, as apparent in Malaya and Borneo. These arise from a combination of several factors:

(*a*) the torrential downpours are often so intense that for a few hours the surface water is greater than streams can carry off, or subsoil can absorb;

(*b*) the density of the vegetation cover impedes run-off;

(*c*) differences of downpours in nearby rivers frequently cause a swift rise of level in one stream and not in another which it joins, so that at the confluence (Fig. 20) the stream in spate dams back the other and the flood may even flow into it, or build bars of silt across it. The Tonle Sap marshes suffer from Mekong floods in this way;

(*d*) where a drainage system has cluse (as in Malayan streams) or similar constrictions (as in the Irrawaddy gorges) these features

may induce flooding of the valley above the narrows. The Tasek Bera of Malaya in this way reflects constrictions in the Pahang Valley;

(*e*) the presence of levees means that the zone between them and the foothills has difficulty in draining to the river after a flood or during a downpour, so the levees are generally lined landwards by broad freshwater marshes, as by the rivers across the Korat Plateau in Siam (Fig. 90);

(*f*) where local rain seasons coincide with the arrival of spates, originating elsewhere in the local rivers, the landscape cannot shed the direct rainfall rapidly and it induces marshes.

Most of the freshwater marshes are seasonally flooded, drying out quickly in spells of drought, draining when local streams are low, but then flooding to depths up to 10 ft. during wet seasons.

Some types of swamp are man-induced. When alluvial mining is being carried on, dredges and gravel pumps effectively stir up large quantities of river sediment which is carried downstream as the mining effluent (Fig. 21).

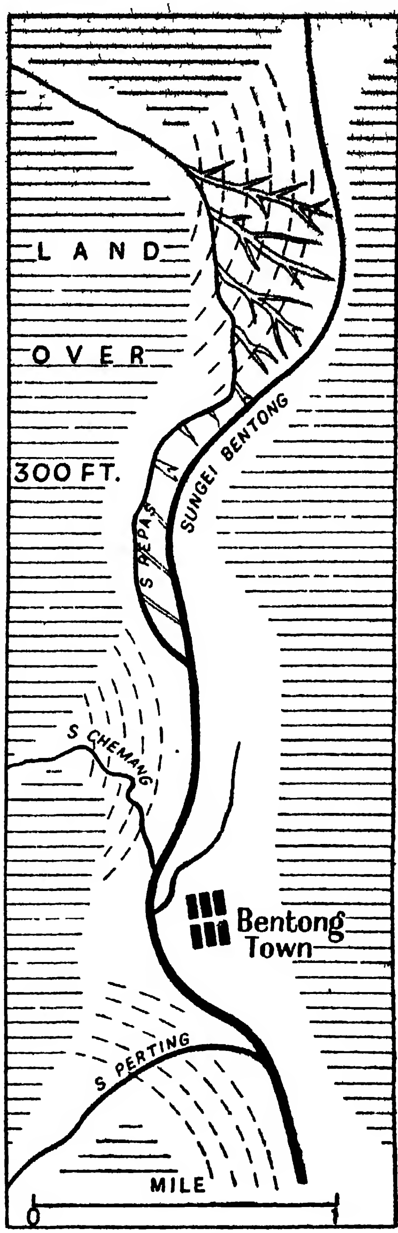

FIG. 21.—Alluvial Fans being thrust across Bentong Valley

This artificially stirred sediment is agriculturally negative and it penetrates the ditches and drains of rice growing areas, gradually silting them up, often spectacularly raising the local river bed (at Serendah in Malaya the river bed was raised 21 ft. by sedimentation over the decade 1923-33), as well as sterilising fields on which the silt spreads so that cultivation becomes more difficult as the river can no longer be kept out. The yields decrease and the fields are abandoned, swamp vegetation gradually obliterating signs of cultivation. Round the lower Malacca River may be found signs of the old field bundings within the tangle of swamp vegetation now growing there, a sign of the effects of mining higher in the river whose effluent is obliterating cultivation in lower areas. This type of swamp comes slowly and has all the appearance of nature overcoming men's efforts to farm, but it is fundamentally a result of man-induced erosions or abrasions elsewhere. Thus interference, by mining and forest clearing, with landforms stabilised over long periods, not only goes on by removal of silt and gravels carried from mining areas and topsoils removed by torrential rains on clean-weeded agricultural areas as a mark of transfer of surface materials from one area, but it also causes the obliteration of cultivation and an extension of useless marsh in the areas where this material is deposited.

Because these tropical marshes occur in zones of human significance, that is, in the flatter areas with agricultural possibilities, and along the coasts where settlement from overseas might take place, they have played a major part in conditioning the distribution of human beings in Southeast Asia. Both the coastal and inland marshes are tree-covered, making it even more difficult to penetrate, control, or cultivate them. Varying degrees of swampiness often account for the ease of development of farming in one place rather than another in Southeast Asia and a broad belt of marsh has generally proved a greater human impediment than any other topographic feature.

Chapter Four

SOUTHEAST ASIA'S NATURAL VEGETATION

Tropical Forest Factors

THE heavy, evenly distributed rainfall and constant high temperatures of most of Southeast Asia encourage continuous plant growth and a profuse, very varied flora. Because the whole year is here a growing season, plant life becomes almost overpowering in its rate of growth. This region contains more species than any other; the flora is not yet completely known, but some 35,000 species of flowering plants alone are thought to exist there (van Steenis). On Borneo at least 11,000 species have been listed, according to Merrill. This contrasts with the parallel figure of 13,000 species for the whole of Tropical West Africa (Good). Woody plants predominate and 15 per cent of the species are trees whose mature trunks are over 16 in. in diameter. The profusion of species is due to (*a*) the predominantly warm, moist climate, (*b*) the constancy of this climate over long geological periods, (*c*) the variety of relief and islands producing minor adaptations, (*d*) the rapidity with which selective and adaptive evolutionary processes can establish new characteristics in a tropical climate which has no resting season, and (*e*) the migrations of plant types from both Asia and Australia.

Southeast Asia was originally clothed by nature almost entirely by a tree cover. Only in modern times has there been any extensive clearing because apart from firing, primitive people were technically incapable of removing the forest. Some clearings became permanent for cultivation, in recent centuries, but the majority have been temporary and partial clearings, later left to natural replacement by a selective vegetation such as grass, savannah or scrub. Temporary clearings resulted largely from systems of shifting cultivation which finally abandon an area, partially cleared by fire, to a series of quick-growing plants, becoming after a few years a secondary forest which may, over prolonged periods, evolve to be scarcely distinguishable from primary forest.

The system of migrant agriculture or shifting cultivation, in Malaya called *ladang* and in Burma *taungya*, is widespread through-

out Southeast Asia and it may be this form of nomadism has in fact operated so long that it affects nearly every acre of the region, thereby exercising a distinct selective action on the whole forest (Sauer). Much forest which we call "primary" may be senile secondary. This is evident in more densely populated areas such as Java and Tonkin, and over the centuries may have no less influenced the forest types of even thinly populated zones, as Borneo still is. In this sense "primary forest" is a relative term, to be retained for convenience rather than as presupposing an absolutely virgin tropical forest.

Two main types of primary lowland forest may be distinguished, the critical factor being drought:

1. In those zones astride the Equator where no season may be called dry, the natural forest is a tall, leafy, congested and evergreen type known as Tropical Rain Forest, sometimes called Equatorial Rain Forest. It may even occur well away from the Equator, towards the northern limit of Southeast Asia, where certain local conditions create a more continuously wet climate than is normal for the latitude.
2. In localities where there are several consecutive months practically without rain, a shorter and more open forest type develops: it has deciduous foliage on the whole, and considerably fewer species. Deciduous Tropical Forest is more generally known as 'Monsoon Forest' and occurs over huge areas in eastern Java, Burma, Siam and Indochina.

Between these Tropical Rain Forests and Monsoon Forests, there are intermediate types and transitional areas where no single meteorological criterion can be used to define the boundary sharply. Within both types, local peculiarities of soil porosity, number of rain-days, relief, exposure and aspect all induce minor variations. In any given unit of this mountainous region, three zones of vegetation may be distinguished within both main forest types, these zones being more distinctive in their differences than the variations of vegetation from one part to another of this huge region. These zones are: (1) coastal vegetation, (2) lowland vegetation, (3) mountain vegetation.

(1) Coastal Vegetation

On shores predominantly sandy, short herbs, grasses and shrubs with creeping stems and fleshy leaves are found; these plant

groups resemble those of salt-tolerant vegetation on European beaches of which spinifex is a sample. Behind this shore grows a distinctive strip of what may be called *beach woodland*, sometimes referred to as beach forest. On reefs, on muddy shores and estuaries, where there is diurnal flooding at high tide, the *mangrove* forest develops. When the shore is rocky, lowland forest may reach high tide mark. In this vegetation seeds and fruit are water-borne so that currents are an important means of dispersion.

Well-developed beach woodland forms as a ribbon rarely more than 200 ft. inland from the shore and contains tree types not usually seen elsewhere and often reaching 90 ft. in height. The typical tree, the casuarina (Equisetifolia, rhu, ru, tjemara) is rather like a conifer to look at and is related to Australian she-oaks. Sometimes the casuarina is in pure stands; at places the strip includes screw pines (Pandanus), the leathery-leaved Calophyllum, Inophyllum and Barringtonia. Coconut palms, which can take root after nuts have been dispersed by sea-currents, are now prominent in beach woodland areas as a planted crop, but they occur self-sown everywhere through the islands.

Mangrove forests are widely distributed on sedimenting shores throughout Southeast Asia. The fringe of mangroves is interrupted where rocks or cliffs come to the sea and when drainage control has diminished the silt from terrestrial sources. Where mangroves develop, silt is being deposited at a fast rate (sometimes to a thickness of 1½ in. annually); the mangrove thus both raises the surface level and progressively presses farther seaward. Whether mangroves grow only where silt is being deposited or whether they cause silt deposition by their root system, obstructing tidal currents and flood run-off, is still disputed. Possibly both processes operate together. The net effect is one of raising the land level and reclaiming land from the sea. In addition, the wood of mangroves is valued for firewood and charcoal; the bark is sold extensively for tanning. The mangrove trees are of some thirty species, all with structural adaptations enabling them to root in unstable muds and to tolerate daily inundation of their root system by saline tidal water. In addition to the tree, there are shrubs, herbaceous plants and ferns (particularly Aerostichum aureum). The trees are evergreen, sometimes 100 ft. tall, mostly with shining, leather-like leaves, small flowers, and unusual root systems. Some (as Rhizophora) have many roots supporting the trunk which begins well

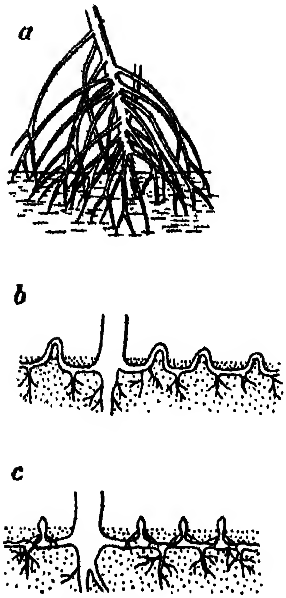

Fig. 22.—Mangrove Root Types. (*a*) The stilted roots of Rhizophora. (*b*) The knee-roots of Bruguiera. (*c*) The up-growing roots of Avicennia

above mud level, as though supported by flying buttresses (Fig. 22). In others (Avicennia and Sonneratia), the main roots are horizontal with many small branches exposing themselves through the mud to stand up above its surface in great numbers covering a wide area round the tree. Another mangrove, Bruguiera, has lateral roots which bend in loops showing above the mud; these loops are called knees and make a great obstacle to movement between the trees. These special root adaptations protrude through the mud to reach free air and they have breathing pores (lenticels); their function may be to oxygenate the roots but they also enable fresh rootlets to be put out at higher and higher levels as the mud and silt increases and stifles the older roots. Many mangrove plants have seeds which germinate before leaving the parent tree. Being heavy and fleshy, they can stick firmly in the mud at low tide or may float away in the tidal currents for considerable distances; other germinated seedlings are shaped like darts to pierce deeply into the mud when they fall.

The main differences between mangrove species are the result of selection according to the amount of tidal inundation they can tolerate; the tide is the chief selective factor in the vegetation pattern from place to place in any one mangrove forest and results in a belt zonation of types roughly paralleling the shoreline. The seaward plants, the pioneers, are most tolerant of salt water; the inland fringe is of the least salt-tolerant types and, as the silt is progressively built up, tidal effects diminish and the vegetation gradually turns into a freshwater swamp with different associations.

The nipa palm (Nipa fruticans), with short stem and feathery leaves often 18 ft. long, lines many estuaries where tidal influence is weakening. It is a palm of brackish but not saline preferences and is extensively used for thatching huts.

(2) Lowland Vegetation

Tropical Rain Forest.—This primary forest is evergreen, tall and profusely-leaved, but by no means gloomy; the forest floor is usually dappled with sunlight at midday and the undergrowth is fairly thin, except at the edges of roads, paths or rivers, where extra

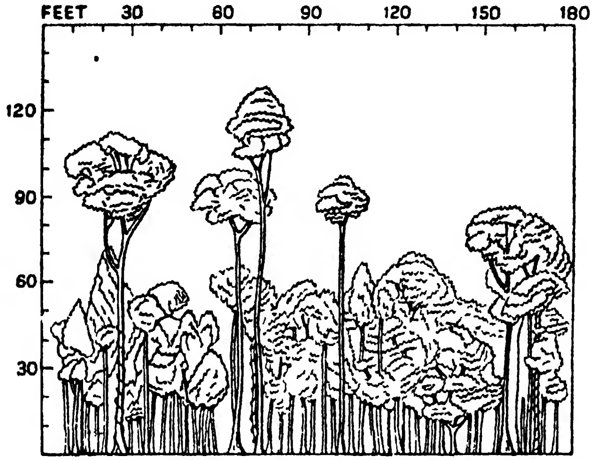

Fig. 23.—Tropical Rain Forest in Profile. The diagram represents a strip of forest 180 ft. in width. Note: (i) the height of the trees; (ii) the crowns are represented in a conventional manner

light induces dense ground vegetation. Within the forest, air is still and constant at temperatures as much as 10° F. below those at the top of the forest. Plants with showy flowers are unusual; variegated and multicoloured foliage is common, while not modifying the general impression of a dark green landscape.

It is the Tropical Rain Forest which most often gets called "jungle." This word, however, has been applied so loosely from district to district, to vegetation types ranging from forest to dry scrub, that it has lost precise meaning and should be avoided.

A distinct structure shows in Tropical Rain Forest, based on height and light. Trees some 190 ft. high are scattered throughout the forest, jutting their isolated heads through a layer of foliage some 60 ft. high, where the crowns of trees touch one another to form a canopy or storey (Fig. 23). Below this are shrubs, saplings and herbaceous plants, all shade-loving types and thinly scattered. On the whole the trees are evergreen, though there are distinct

leaf changes in individual trees. This change of leaves is not regional and some trees retain old leaves until new ones are well formed. The general impression of evergreen persists as a result of a non-synchronous leaf rhythm. The degree of correlation between flowering, leafing and climate varies considerably; certain of the forest plants flower after a few days of drought or a slight local drop of temperature, as in thunderstorms, others persist in annual rhythms whatever the local weather may be, some correlate with the local peaks of rainfall, and some assume a fifteen months' periodicity. Each storey of trees has special features; the topmost storey has thin straight boles despite the great height of the trees, and is inclined to flattened crowns of undivided, tough, oval leaves. Many of the tall trees have plank buttresses, thin outgrowths extending up to 15 ft. from the ground, stabilising the relatively thin boles in soils not well suited for root anchoring, and presenting a major difficulty when the trees are to be felled. Second storey trees are in general smaller in every respect; their leaves are proportionately larger, extending to long fine points.

Two groups of plants fit into this tree ecology: (*a*) the lianes, (*b*) the epiphytes.

Lianes are woody creepers, often several hundred feet long, which climb from the ground using hooks and tendrils on the tree-trunks in order to reach the sunlit crowns. They use trees as supports only and spread in great festoons from tree to tree; their flowers are in the upper storeys and their stems may be from finger thickness to as much as 10 in. in diameter. Rattans are typical lianes, their strong thorny stems being much used as native ropes and wires.

Epiphytes include orchids, ferns and wild figs. Their seeds become established in high branches and are adapted either to live self-contained above ground, or as in the case of the strangling fig (Ficus), to send down very long roots which ultimately fasten in the ground. Only certain of these epiphytes are truly parasitic, feeding on the sap of a host; most of them are merely supported by the host-tree. The fig sends down tough quick-growing roots round the trunk of another tree, finally strangling the host until it rots away, leaving the fig tree sustained by a hollow network of roots. This particular plant, the seeds of which are both bird-carried and wind-borne, may prove highly destructive to stone structures, as in the case of the Angkor temples.

Tropical Rain Forest is remarkable for the number of tree-types which go to make it and for its heterogeneous composition. Continuous stands of any single tree species very rarely occur, and often thirty may be found in a forest patch 100 yds. square. While the trees differ widely, the family group Dipterocarpaceae, gigantic in dimensions and bearing winged seeds like shuttlecocks, is the most prominent. Within the forest individual trees are restricted by the congestion so that the shape of high trees in tropical gardens or along roads is no guide to their shape when in their natural setting.

From the thousands of tree types in this forest some commercially valuable timbers, gums, resins and camphor can be obtained. Most of the trees, however, are commercially useless; the heterogeneous composition and density of the forest operates against exploitation of even those species which could prove useful.

Within the Tropical Rain Forest, several subsidiary types may be recognised.

(*a*) Parts of Borneo, Sumatra and Malaya have a white, porous, sandy subsoil thought to be a tropical podsol (see Chapter 5). Upon this, pitcher plants, conifers and a treeless, heathlike ecology of grasses and shrubs may develop.

(*b*) Upon porous limestone landscapes, the trees are short and epiphytic plants are most common, since these can tolerate the absence of groundwater.

(*c*) Behind the mangroves and transitional between them and the true lowland Tropical Rain Forest, are Freshwater Swamp Forests, extensively developed in Sumatra, Malaya and Borneo. The plants peculiar to this swamp setting vary with the duration of freshwater flooding. Trees here are shorter, fewer in species, well-buttressed and often stilt-rooted. Over considerable areas stands of a single type of palm may occur and palms of short varieties cover the ground to impede movement. Sometimes on the east coast of Sumatra the Freshwater Swamp Forest produces a tropical bog on peat soil formed by rotting vegetal remains several yards deep.

Secondary Forest.—The sequence of vegetation which replaces Tropical Rain Forest after removal is called Secondary Forest, made up of ferns, tropical grasses and scrub. It may be subdivided into distinct vegetation types which are various stages in the transition from naked ground to tropical forest. The process of replace-

ment depends for its character in detail on the length of time the forest clearing has continued in cultivation, the extent of soil erosion, the clearing suffered, the original soil type and the proximity of natural forest from which seeds may be derived. To go through these replacement phases, natural vegetation is thought to need at least two centuries of most favourable conditions before it will become anything like Primary Tropical Rain Forest again. During the transitional stages spontaneous fires often occur, to prolong the replacement period; grazing animals have similar selective effects.

The normal replacement succession is first herbaceous grassland, then shrubs and finally trees. Tropical grasses, coarse, tough and in tussocks, quickly appear on any newly exposed ground and reach a height of 5 ft. These grass landscapes, on which Imperata Cylindrica is typical, often resemble savannah. The grass burns rapidly and regrows quickly because it spreads by subsurface root runners shielded from the effects of burning. Quick-growing tropical grass stifles most other vegetation, so that it is both a sign of inferior soils and may even be the cause of them. While grass is the most prominent type, sometimes wild sugar canes establish themselves.

The scrub consists of wild ginger and a tropical rhododendron (Melastoma malabathricum). Giant ferns spread rapidly and compactly in some districts as pure stands in which bracken (Pteridium) appears prominently.

Young Secondary Forest develops trees some 30 ft. high in a few years but the earlier successions leave behind a dense undergrowth and many giant creepers. Stands of the same species persist for some time and the trees are at first of fast growing, soft wooded varieties. Pines are fairly common in some local secondary vegetation, the older types of which are scarcely distinguishable from Primary Forest except for the thick undergrowth.

Monsoon Forest.—Because Monsoon Forest has a distinct dry season, it is subject to widespread and frequent fires which exercise a selection in favour of deep-rooted or thick-seeded types which can regrow after a forest fire. Shifting cultivation is thought to have had a greater effect in Monsoon Forest areas than on the Tropical Rain Forest, so that Monsoon Forest may be largely a secondary rather than a primary forest type. The type stretches across Southeast Asia in two broad zones, roughly symmetrical to the Equator. The

argest zone covers Burma, Siam and Indochina, while the counterpart in Eastern Java, the Sunda Islands and New Guinea covers a much smaller area, with local variants due to insularity. These zones are identical with the dry areas of Fig. 10.

In the rainy season, Monsoon Forest resembles Tropical Rain Forest. Its tree heights are less, the foliage not so profuse, and the spacing more open. Only the undergrowth remains fairly green for the whole year; the rest of the vegetation sheds leaves in the dry season, when the forest has a bare, stark appearance. Herbaceous plants, lianes and bamboo are common but epiphytes are unusual and the herbs almost disappear in the very hot dry season. Among the trees, Acacias and Albizzias are especially common and Leguminosae are prominent.

Some observers distinguish between wetter and drier types of Monsoon Forest, both transitional from Tropical Rain Forest to Tropical Desert, the latter being outside Southeast Asia.

Monsoon Forest is mostly of mixed species but sometimes a single species dominates, possibly as a result of selection through repeated burning. Of these, teak forests (Tectona grandis) are characteristic and important commercially, occurring in Northern Burma, Northern Siam, Eastern Java and the Moluccas. So valuable has teak proved itself that some existing forest areas are actually re-plantations of it. Teak has thick hard-cased seeds which are fire resistant. Its saplings come through fire successfully and the pure stands are thought to have been the result of natural selection on these lines, since it is fairly certain that forests of teak alone do not occur under natural conditions. Teak reaches to heights of over 120 ft., the lower half of the tree being straight and unbranched under forest conditions. Undergrowth is negligible and the ground is covered with brittle teak leaves which often cup, forming mosquito-breeding places in the wet season.

Resembling the teak forests in origin, eucalyptus forests have developed in the eastern islands as migrants from Australia, occurring naturally only in New Guinea, Timor, the Lesser Sundas, Celebes and the Philippines.

Another single stand deriving from the Monsoon Forest by selection, is bamboo forest. Considerable areas almost exclusively occupied by bamboos are found in the northern parts of Southeast Asia, with small patches in East Java. Bamboos in great variety grow everywhere in Southeast Asia and they have been planted

extensively because of their usefulness structurally and domestically, but continuous stands become established only where the dry season is very marked and where shifting cultivation is known to have been practised extensively. Bamboos are giant perennial grasses of about a hundred species, with woody stems and woody roots. They grow in clumps and may be evergreen or deciduous. Some bamboos flower at long intervals (25-70 years) and their seeds are fire-resisting. Constant friction between the dry woody stems may cause forest fires and help to produce that selective process which leads to stands of bamboo.

Monsoon Dry Forest, an open wooded landscape containing very few species, may be found over large areas of Burma, Siam and Indochina in association with poor soils. Known as *indaing* in Burma and *padeng* in Siam, this forest develops where rainfalls are not much above 40 in. per annum, and it may merge on the equatorial side into Tropical Rain Forest and on the other into dry or thorny savannah vegetation. Within Monsoon Dry Forest trees are widely spaced, tending to be stunted forms of Dipterocarpaceae and distinctly deciduous.

Secondary Monsoon Forests.—Considerable areas of savannah found in Burma, Siam, Indochina and the Eastern Indies are secondary growths after a removal of the natural Monsoon Forest. Savannah is open country of tall, coarse grasses, occasionally having a few scattered bamboos or low trees and very much associated with long dry seasons whose effects are aggravated by poor or porous soils. Savannah merges into Monsoon Dry Forest and is often covered with low palms (Borassus flabellifer), and contains prickly pears, spiny cactus-like plants, and similar thorny scrub.

(3) Mountain Vegetation

Vegetation steadily and often imperceptibly changes with altitude and the resulting types are much the same, level for level, throughout Southeast Asia. All but the very highest mountains are forested, though the trees on exposed summits are dwarfed; only in New Guinea and Yunnan are the heights great enough entirely to prevent tree growth and produce an alpine vegetation. Young volcanoes may be treeless for pedological, rather than for climatic reasons.

Above about 2,000 ft., at most points of Southeast Asia, large

trees of Dipterocarp type gradually disappear and temperate trees of the oak and chestnut type become commoner, though the landscape continues full of giant bracken and tree ferns. Higher still the vegetation dwarfs considerably, shadiness diminishes, and woody plants become twisted and gnarled. This often turns into a moss or "elfin" forest above 5,000 ft., in localities where the air is constantly cool and saturated, to produce thick blankets of wet mosses and liverworts upon all other vegetation. Mosses hang in fantastic festoons everywhere and sometimes (as in Borneo) form walls or platforms under which other vegetation, such as dwarf oaks and rhododendrons, are buried (Harrison). Moss forest will not occur in localities with a noticeable dry season: in monsoon areas it is replaced in succession by pine forest, in which, however, some broadleaved trees persist. Above both these mountain forest types (above 6,500 ft.), mountain grasses and shrubs form landscapes of rolling downlike appearance.

FAUNA

Between the western and eastern fringes of Southeast Asia there are greater differences zoologically than between Asia and South America, even though these are separated by the Atlantic (Merrill). The differences derive from the long separation of Australia from Asia. Migration has gone on from Asia and Australia into the islands and peninsulas of Southeast Asia which is thus a transitional zoogeographical region (Fig. 24).

The Tropical Rain Forest has complicated ecologies of living creatures associated with the various storeys and the variety of these creatures parallels the variety of vegetation. Large animals such as elephants, tigers, rhinoceros, etc., are relatively few and confined to the coastal sections. Specially numerous are arboreal and flying creatures, butterflies, birds, moths and insects. These are able to migrate from place to place with considerable ease so that the convergence of Asiatic and Australian species has gone on fairly freely. The contrasting zoological types are summed up in the difference between mammals; in Australia, except for a few bats and rodents, mammals are marsupial (pouched) or monotreme (single vented); in Asia these groups are entirely lacking and are replaced by placental mammals, monkeys, shrews, squirrels and ungulates.

By far the richest zoological group is that spreading from Asia.

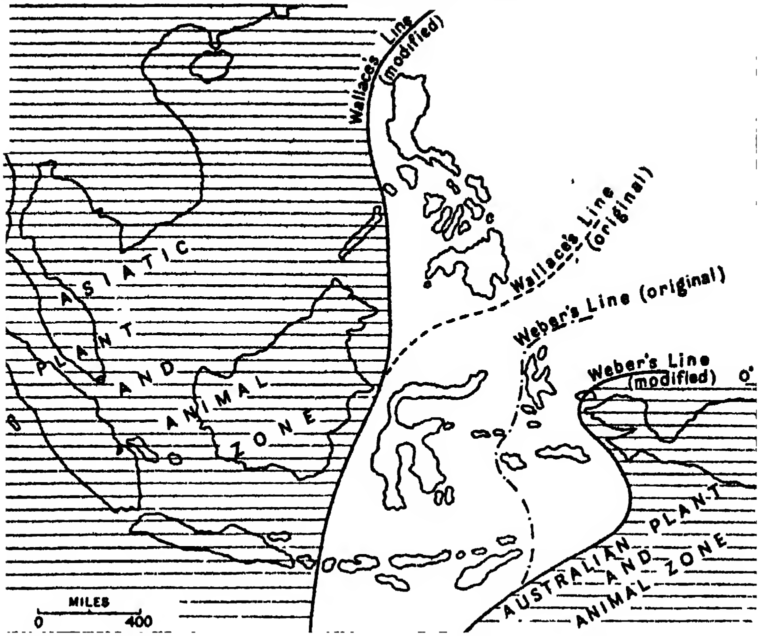

FIG. 24.—Biological Regions of Southeast Asia

For a long time Wallace's Line was held to demarcate these zoological types; Wallace himself drew the boundary just west of Lombok and Celebes but Huxley later extended it to include the Philippines in the "Australian" zone. Geographically the boundary clearly correlates with the limits of the Sunda Platform and the interglacial connection between Malaya, Borneo, Sumatra and Java appears to have permitted zoological migration fairly uniformly among them, whereas there has been no continued land connection between the "mediterranean islands" east of the Platform. Later more detailed study of the fauna has produced criticisms of the Wallace Line. The steady pressure of zoological types eastward has been demonstrated and Weber laid down another limit which he showed more closely to accord with the balance between Asiatic and Australian fauna. East of it Australian types dominate. Wallace's Line thus is now best thought of as the eastward limit of the typically Asiatic zoological types; it is matched by a line just west of the Sahul Shelf which is the westward limit of exclusively Australian and New Guinea faunal types.

Between this and the Wallace Line is the zone of tectonic instability, the "mediterranean" zone, where faunal destruction followed by re-population from nearby continents has gone on fairly frequently, but irregularly and without uniformity from place to place; Weber's Line is roughly marginal to this "mediterranean" faunal zone.

Chapter Five

SOUTHEAST ASIA SOILS

Factors in Tropical Soil Development

While most soils of Southeast Asia have in common the fact that they have been evolved under conditions of plentiful moisture, they vary very considerably and the term "laterites," frequently used to describe them, is so broad that it misleads. In the tropics, as elsewhere, soils represent a synthesis of the inter-related factors of climate, parent rock, plants and animals, relief and drainage; a change in any one of these factors will cause a change of soil character. Time, too, plays a considerable part. If the factors operate for a period indefinitely long, the soil type conditioned by them will evolve until the soil represents a perfect balance or end product of them. When the forest cover is removed or a volcanic eruption throws out new rock material, certain of the factors are changed, the soil reverts to a more juvenile stage and its evolution begins again on different materials and may take a different form. Thus soil differences from place to place are often due to differences in stage of evolution, in the time factor.

Southeast Asia weathering is fairly uniform from place to place. It occurs without exposure to frosts or to wide alternations of heat and cold, but under conditions of warmth and heavy rainfall. Hence the weathering process is chemical rather than mechanical.

Those regions of Southeast Asia away from the Equator and having a markedly seasonal rainfall (as in the dry belts of Burma and Siam) may be described as subject for part of the year to equatorial soil processes where surface evaporation is nearly nil and for part to desertic soil processes in which surface evaporation is at a maximum.

The warm rainwater of tropical conditions, well carbonated and charged with the biochemicals of vegetal disintegration, breaks down the silicates, which form most rocks, into salts which are leached away, leaving the complex sesquioxides to accumulate in the soil. These may in turn undergo selective changes, all leading to the accumulation of clays. In the tropical heat of Southeast Asia

lowlands these changes, known as the hydrolysis of the silicates, most involved phases of soil chemistry, take place very fast compared with those of European latitudes or of high mountains, and reach the "end-product" or mature stage quickly. On the Sunda Platform and the Sahul Shelf, prolonged geological stability has in any case brought the mature stage in local soils, but even the more juvenile types of soil on the younger volcanic structures are rapidly evolving towards maturity. Adding further to the complexity of Southeast Asia soils is the variety of rock types and the varied lengths of dry season towards the margins of the region. Thus the diversity is great, although differences in the soil end-products is lessened to some extent by rapid maturity under a single broad weathering type—the warm, damp tropical.

Tropical Groundwater

With certain local exceptions, Southeast Asia experiences an annual excess of rainfall over evaporation. This means that there is a steady movement of rainwater downwards, percolating through the soil as a dilute solution of chemicals from the air and from plants, capable in turn of dissolving some solids in the soil. While some of the soil compounds are produced by the decay of vegetation, the plants depend on the groundwater to dissolve those which become plant nutrients and are absorbed through the root systems. Not all solubles enter plants; most of them are just carried away. The continued downward movement of the soil water effects a steady removal (leaching) of the solubles in Southeast Asia soils. While a thick vegetation cover continues to be in place upon the surface, replacement of some solubles by humus renewal goes on all the time, but once that vegetation is removed, the surface soil rapidly loses its existing soluble elements, receives no renewals, and becomes infertile, a factor making continuous agriculture a drain upon the soil which not only loses its qualities by greater leaching but in addition loses by that which is absorbed into the cultivated plant. Where, however, there are breaks in the cycle of leaching, as in areas having a dry season, the soil water is for a time subject to a condition where evaporation exceeds rainfall, the leaching ceases and there begins the accumulation of soluble plant nutrients or even the drawing up of solubles from depth by capillary processes. These zones, where soil impoverishment is seasonally checked, are those with dry seasons, i.e. from Central Java eastwards, in the

monsoon zones of the Kra Isthmus and northward into Burma, Siam, Indochina, a factor in the greater fertility, agriculture and population of those zones compared with the equatorial areas.

Solution by groundwater, however, is not peculiar to tropical latitudes—it goes on elsewhere. The distinctive point is that high tropical temperatures and heavy rainfalls give groundwater great power both to dissolve and to carry away special selections of the solubles. Easily soluble components of the soil disappear wherever rainfall and groundwater are ample, but the order in which sandy elements, clay elements and iron oxides (the main colouring element) are leached depends on the organic content and temperature of the groundwater. Water containing large quantities of organic material is a rapid solvent of clay and iron compounds; when groundwater is of this type, the silica occurring in the soil in the form of quartz remains scarcely touched for a long period, according to Glinka, causing the mature topsoil to consist largely of sandy elements bleached white by the removal of iron oxide colouring and the mature subsoil to show signs of re-precipitation of the iron oxide at lower levels. This is the process of *podsolisation.* On the other hand, where its organic content is low, groundwater breaks down any silica in the form of complex aluminium silicates faster than the other compounds and removes certain elements of it, so that there remains an upper soil consisting at maturity largely of stable clays and iron compounds, strongly coloured red, yellow or brown. This process is *laterisation*, the dominant soil process in Southeast Asia. The end-product of laterisation may be called laterite, a porous, crumbly-textured, bright red soil often hardening on exposure to the air and composed almost exclusively of clays and iron compounds, and much the same whatever the parent rock. Only in limited areas is this laterite fully developed; elsewhere the process has not reached its final or mature stages so that most Southeast Asia soils may more aptly be called laterised, that is, at an intermediate stage of laterisation. This stage may be assessed by measuring the proportion of silica to the alumina; the higher the silica content, the less laterisation has taken place (Polynov).

The whole process of laterisation involves very special aspects of complex chemical and physical changes which await the researcher for clarification.

The organic content of soils depends in turn on temperature

which conditions the rate at which soil bacteria and fungi can break down dead leaves and other plant remains, first to the dark-coloured humus and then to chemical compounds. Thus there is a steady addition of decaying vegetable matter to the soil as trees and plants drop their leaves or die, and a continuous depletion of it as bacteria complete its breakdown. The balance between them is established by temperature and in the tropics where soil temperatures remain so steadily above 75° F. the breakdown by micro-organisms is considerably faster than the vegetation, profuse as it may appear, can replace. Thus the organic content of laterised soils is relatively small, and confined to a few inches of topsoil, beneath which practically no humic solids or liquids will be found. In vegetation-covered localities, shielded by the canopy of trees, where average soil temperatures may be well below 75° F., accretion of organic matter exceeds depletion, enabling humus to accumulate and form black-coloured soils.

Where the soil is waterlogged, a widespread condition in western Southeast Asia, bacterial action is hindered by the exclusion of oxygen so that, whatever the soil temperature, dead vegetation accumulates, often in the form of thick layers of peat. Altitude, by lowering the soil temperature for periods below the critical 75° F. (Glinka), is also responsible for variations in the humus content of soils. In Preanger (Java) for example, the top soil gradually changes from one with a slow humus content and red colour on the foothills, through brownish, with an increasing humus content at altitudes of 5,000 ft., to become dark brown or black at higher levels on mountains. The relative subsoils are red in the foothills, where laterisation predominates, and gradually change to dirty white at higher levels where podsolisation and bleaching are aided by the lower temperatures.

Examples of local podsolisation in the tropics have been observed upon parent rocks of exceptionally porous character, as in the coarse sands and sandstones of Banka, Borneo and Malaya over which distinct bleached earths occur. Why laterisation should be replaced by podsolisation under these conditions is not clear, but the sandy, white or bleached soils are unmistakable. Thin Secondary Forest is normally the vegetation cover of such districts, whether as cause or effect of the podsolisation has not been determined. Glinka quotes examples where excessive moisture and humus have bleached certain soils among laterites and notes that

podsols developed under these conditions in the tropics differ chemically from analogous types in temperate climates. He reports the possibility that white laterised soils may derive from rocks containing magnetite forms of iron, which will not break down into ordinary brownish oxides under weathering.

Laterised Soils

While the characteristic colour of laterised soils is red, some of them have bright yellow colours which, however, do not indicate major chemical differences, except that the various types of iron oxide are more intensely hydrated. The colour distinction is now held to be of minor importance. Sometimes a red mottling breaks the uniformity of the yellow colouring; this is thought (Pendleton) to be connected with aeration along dead roots of plants, which have now disintegrated. Occasionally the fine channel of a root can be seen at the core of such mottlings, cross-sections of which often have ringed or oyster-shell patterns.

Laterisation produces end-products not materially differing however different the parent rocks may be, so that tropical red soils develop to much the same appearance over granite and over limestone, although the rate of maturing varies. On the other hand, the chemical character of parent rock may show for a considerable time in the laterised soils. Thus, the igneous rocks of Sumatra and Java are in some regions basic and in others acid. The more acid type of igneous rock contains very little calcium and phosphorus, weathering slowly into poor soils, whereas the basic rocks initially contain more of these elements and release them readily, to weather in the tropics into soils whose composition makes them more fertile. The leaching continues rapidly, and at a more advanced stage of weathering the soils from basic rocks are no richer in these solubles than those from acid extrusions. This accounts for great differences in the agricultural potential of the flanks of different volcanoes in Java, where any thinly populated zone may safely be interpreted as a zone of soils lying over acid igneous parent rocks, or of overmature soils upon basic parent rocks. Pedologists disagree as to whether mature laterites can be derived from every type of rock but the majority incline to accept this point of view. Pure quartz sandstone, however, resists laterisation and quartz veins persist unweathered long after the original rocks containing them have broken down.

The term "laterite" (from L. later, brick), now limited to mature laterised soils, has had a history confused by varying definitions. It was used in India by Buchanan in 1807 to describe a tropical soil containing large quantities of iron, soft enough to be cut with a spade or mattock, yet rapidly hardening on exposure to sun and air into an excellent constructional material much used for tropical buildings. Afterwards the term became loosely used for any reddish

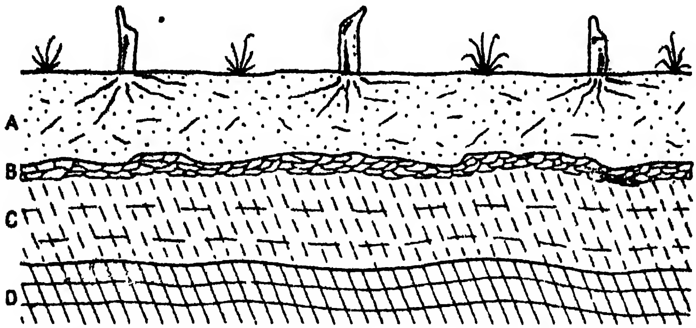

FIG. 25.—Section of Laterised Sandstone, Korat. Surface burnt for shifting cultivation. (*a*) Reddish-yellow sandy layer with tubular ironpan along old root-lines. (*b*) Lateritic ironpan and granular concretions, 6-12 inches thick. (*c*) Weathered sandstone, some bedding still showing, tubular passages (old roots), brownish-red. (*d*) Red sandstone of Korat, lightly consolidated, hardly deformed

tropical soils. Discrimination in the use of the word is modern and the standards are by no means uniform.

At best, only certain layers or horizons of laterite will harden on exposure. When this type of laterite is used structurally, being an end-product of weathering, it resists further weathering and buildings made of it stand up to the tropical climate better and longer than any other local material, evidenced by the old fort at Malacca and the temples of Angkor whose laterite slabs are firm and square after centuries of exposure.

Mature laterites may be up to 100 ft. thick, all weathered *in situ* and justifying the word "soil" to describe it. Several distinct horizons occur within this thickness. On top is a few inches of forest soil, dark with humus and partially decayed matter (Fig. 25). Under this is red earth, crumbly and sticky to the hand, permeable to water yet easily "baking" if ever exposed to the direct sun. Much of the water is held colloidally so that percolation wells can rarely be used in laterised ground. Four or five feet below the surface a

distinct cellular structure develops, consisting of a coarse network of iron compounds round softer cores of clay. This is the horizon which may be of that hardening type suitable for a structural material. Sometimes the iron compounds at this level change *in situ* into hard concretions like a pan roughly paralleling the surface and looking like a lustrous slag. These crusts or concretions ring like hollow iron and might be mistaken for volcanic material. Containing up to 30 per cent of iron, they have at times been smelted, but extensive use for this purpose awaits development of a suitable

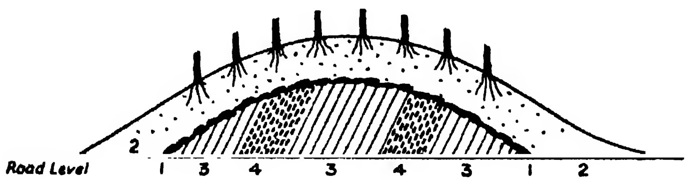

FIG. 26.—Section in West Singapore: Hill with Partially Removed Rubber. 1. Lateritic ironpan running across bedding planes. 2. Red subsoil, 3 feet thick. 3. Partially removed shale. 4. Conglomerate

process. Oxide of manganese occurs in these concretions as well. The pan may be continuous beneath a large area and prevent percolation, and in deforested areas the softer topsoil may be washed away, or slide down the surface of the iron pan which then shows as a compact platform inhibiting secondary vegetation.

The concretion of iron compounds is thought to be connected both with seasonal variations of the subsoil water level and with electrolytic changes in descending water heavily charged with solvents. Fracture planes, by creating internal drainage lines, encourage panning to follow lines unrelated to the surface contours. Skew-panning may also develop strongly along lines of quartz which persists undecomposed through thick laterites. While the iron concretion layer has special interest because of its resemblance to pan layers in other latitudes, it is by no means ubiquitous and some writers relate the pan to igneous parent rock. The stratifications of laterised soils are more related to the relief of the surface than to stratifications of the parent material (Fig. 26).

Beneath the concretion layer is another horizon of almost continuous saturation where the coloration tends to be less red and more yellow or whitish right down to the horizon of decomposing rock. These deeper horizons represent less advanced stages of

weathering, repeating at depth some of the variations noted at the surface in less maturely laterised soils elsewhere.

Cuttings through laterised soil, as for roads and railways, frequently develop a dark crust after exposure, giving the sides of the cuttings an appearance of hardness belying the soft soil beneath it. Occasionally these exposures are honeycombed where softer parts have been washed away by rains, leaving the cellular structure of iron compounds fully evident. Because laterised soils are so wet and thick, the destructive processes of slumping and slipping assert themselves strongly. Soil creep on slopes operates relatively fast, particularly if an iron pan exists not far below the surface. Whole sections of a hillside may thus slump down into a valley leaving a scar which wild vegetation needs a long time to conceal. Road cuttings frequently slump at the sides as though huge spoons had been used upon them. Almost any ditch will show soil creep in the form of root-matted topsoil hanging well out over the side of the ditch.

Polynov and Laterisation

Polynov in his "Cycle of Weathering" has discussed a new interpretation of lateritic soils. Previous pedologists have considered laterisation to be a process peculiar to the high temperature and heavy rainfalls of the tropics. Polynov produces an argument to show that laterised soils may result as the end-product of weathering in any latitude, given a sufficiently long time for the process to operate. In his view the frequency with which laterites occur in the tropics now is due less to the special character of weathering there, and more to its rapidity, which brings soil maturity very much faster than in cooler latitudes. The age and stability of the Sunda Platform and the Sahul Shelf fit into both schemes since soils upon them may be considered to be brought to maturity by uninterrupted weathering during prolonged geologic time, and by the intense and continuous nature of tropical weathering. Whatever the value of Polynov's theory from the soil chemist's point of view, it helps to account for red soils of lateritic aspect outside tropical areas without needing to postulate major climatic changes.

Soils in the Drier Zones of Southeast Asia

Northward from the Equator, Southeast Asia is subject to a longer and longer dry season during which soil leaching diminishes. On exposed soils, the high surface evaporation of dry periods even

induces an upflow of groundwater which evaporates and thereby precipitates solubles in the topsoil. These have sometimes been called the Savannah Soils, found extensively in Siam and Indochina. The type occurs not only where the climate permits but also where destruction of marginal Tropical Rain Forest has gone on at a rate faster than natural replacement. Because tropical forest soil works with a very small quantity of plant nutrients circulating rapidly in a cycle from soil to leaves and back again to soil, the balance is delicate. Where the forest is almost virgin, natural fires do little damage, but persistent burning by men may break the cycle of nutrients and release altogether the small initial capital of solubles. The iron concretions under such conditions become firmly cemented into subsurface platforms inimical to anything except coarse tropical grass and the topsoil is exposed to rapid removal by torrential storms. The more accessible laterites which received early examination were often under vegetation of the savannah type and they were thought at one time to be signs of a change of local climate, from Equatorial to Savannah, whereas in fact they reflect over-destruction of the original tropical forest, followed by such a change of soil type that the forest cannot re-establish itself. Because laterite is very porous, rain falling upon it may be heavy yet quickly passes beyond the reach of plants, carrying all plant nutrients away, thereby preventing regrowth of the original vegetation cover.

Natural savannahs in Southeast Asia are noteworthy for their extensive iron concretion layers which provide support for the view that vertical fluctuation of subsoil water is a factor in the formation of lateritic iron-pan.

Soils and Agriculture

The different types of tropical forest induce minor differences in the soils beneath them, which assume major significance when the forest is cleared for cultivation. The limited supply of plant nutrients explains that paradox between the apparent fertility of an elaborate and profuse forest vegetation and the poverty of the soil when the forest is removed, the cycle of nutrients broken and most solubles washed away. Eventually clearances in the forest mean an increase in the outflow of nutrients in solution or suspension which are finally distributed into the swamps, the estuaries and the sea. To some extent the practice of burning, which reduces the forest to

ash, lying for a while upon the surface, returns to the soil part of the chemicals of plant structure, yet unless steps are taken to retain this "capital" by terracing or cover crops, the ash quickly dissolves and disappears into the streams. Good crops may be obtained by utilising this soil capital immediately, but it can last only for a season or two, after which the natural infertility of laterised soils becomes apparent. It is not so serious with isolated native clearings, done under the shifting cultivation system, because each clearing is so small, and surrounded by forest, that lost soil nutrients are not carried far before they are recaptured into the forest ecology by the tangle of adjoining vegetation. When shifting cultivation is done too frequently over the one patch, that is, more frequently than, say, once in twenty years or so, then progressive impoverishment of the soil takes place. Maintenance of fertility in clearings is easier in less maturely laterised areas and where there is at least a short, dry season to interrupt the depletion processes.

The basic volcanic rocks of Java as well as the recent ash and mud flows contain chemicals which weather to plant nutrients and, being in addition very young in the laterising cycle, they produce fertile soils. On the older lavas and on the acid outpourings, a maturer stage of laterisation has been reached to produce soils no better for agriculture than other parts of the Sunda Platform. A new volcanic outburst, while creating temporary havoc, may ultimately produce local agricultural prosperity because it brings a new supply of plant nutrients. The elaborate terracing of new volcanic ash landscapes is only partly due to population pressure: it equally reflects the need to restrain the run-off and to hold back the solubles as long as possible.

Apart from the loss of soil fertility due to rapid solution, all bare or clean-weeded soils in the tropics suffer from mechanical erosion by the violent torrential rainstorms. Rainfall of tropical intensity rapidly gullies all bare landscapes and is particularly evident on the less cohesive ashes of volcanic cones, so that another reason for terracing is to offset gullying. Tangled vegetation prevents mechanical soil erosion having any great significances in forested areas, but in Java, where recent ash and intensive cultivation combine to facilitate this type of erosion, rivers contain from 300 to 2,000 gms. of silt per cubic metre; the Irrawaddy has about 750 gms. suspended in each cubic metre. (The Seine and Rhine only contain about 50 gms. of silt per cubic metre.) From tropical forest in a

natural state the soil loss is mainly by solution, and streams running from the jungles are either clear or black with humus content. From clearings, whether natural or artificial, subsoil solution is supplemented by violent mechanical erosion, and streams from these zones are thick and muddy, often tinted red.

Since both the subsoil processes and the surface erosion have water as their principal vector, the solubles and the silt are carried to the deltas and to the freshwater swamps which are the depositories of plant nutrients from all the forested soils. The coastal and freshwater swamps are not subject to rapid decomposition and they progressively accumulate plant foods, hence they function as the chief agricultural areas, continuing to produce without serious soil exhaustion through years of productiveness, as in the Irrawaddy and Menam Chao Praya valleys. These sticky wet soils are black or dark brown, often containing lenses of peat, and completely unlike the laterised soils around them. They are all transported soils, both fluvial and marine sedimentation playing some part in building and shaping them.

PART II

THE COUNTRIES OF SOUTHEAST ASIA

Chapter Six

THE NATURAL LANDSCAPE OF MALAYA

SITED roughly at the middle of the Sunda Platform, Malaya has special interest as a sample of a very ancient landscape scarcely disturbed by tectonic changes which have gone on close to the margins of the Platform. In addition, Malaya is almost entirely equatorial in climatic character, accentuating the maturity of the landscape forms. It also exemplifies the surface effects of that process of marine inundation which followed the glacial epochs of northern latitudes.

RELIEF

Broadly, the country is mountainous. Wide plains, scarcely above sea level, surround the ranges and caused early explorers approaching Malaya from the sea to think the Peninsula was a string of islands. Yet the mountains have no great altitude: Gunong Tahan is only 7,186 ft. and just breaks the continuity of the forest cover, so that Tahan is sparsely covered with thin shrubs through which quartz crystals gleam, an unusual phenomenon in this otherwise tree-covered country, giving rise to the Malay legend that the mountain is made of diamonds guarded by demons.

The mountain ranges stand up most strongly in the northern half of the country but their altitudes diminish southwards where their line disappears beneath the sea to the south, to continue in the hills of the Lingga, Rhio and Banka islands. In Central Malaya meet two sets of ranges; the northern ranges, which lie staggered *en echelon* and skew-wise across the peninsula on NNE-SSW. lines, and the southern ranges of lower altitudes which are less skew to the peninsula and have a NNW-SSE. pattern, apparent also in the Trengganu Highlands. Of the ranges, one called the Central Range, though it lies well to the west, running from Patani in Siam to Malacca, is the most continuous. While differing slightly in detailed structure, all these ranges dominating the Malayan topography have igneous cores which were intruded into very ancient (late Mesozoic) fold mountain systems, possibly

fan-folded with the Central Range as the middle fold, so extensively eroded over long periods that the intrusive granitic rocks within them are now exposed and stand out as the greatest heights.

The ranges are, from west to east:

1. *The Nakawn Range*, reaching the seas as a limestone ridge on the Perlis-Siam border.
2. *The Western Range*, from Singgora through west-central Kedah to the western border of Province Wellesley, with minor outliers in Penang, at Kedah Peak and extending to hills round the Dindings.
3. *The Bintang Range*, from Siam nearly to Bruas.
4. *The Kledang Range*, east of the Perak River and west of Kinta, breached by the Sungei Plus.
5. *The Central or Main Range*, sometimes called the Kerbau or Korbu Range after the highest peak (Gunong Kerbau, 7,160 ft.), stretching in an arc from Siam to Malacca.
6. *The Benom-Mt. Ophir Range*, whose continuity is much broken by east-flowing streams from the Central Range.
7. *The Tahan Range*, running from the Trengganu Highland through Johore and continued through Singapore to the archipelago southward. It is interrupted by the Pahang and Rompin rivers.
8. *The Eastern Range*, the least known, evident from Kelantan to the Pengerang Peninsula in SE. Johore and considerably interrupted by transverse drainage lines.

On either side of the ranges are hills taking their form and pattern from scarps developed upon the folded sedimentaries flanking the lines of granite.

Malayan Rocks

Much of the Malayan rock structure (Fig. 27) is concealed by a thick cover of weathered material and this in turn by the Tropical Rain Forest; only in streambeds, in hills and in mining areas does it show clearly. The main rock formations are:

1. Limestone and calcareous shale: marked on the geology map as a single formation, it may be subdivided into:
   (*a*) massive, resistant, jointed limestone, greyish when newly cut, with minor intercalations of shale. Those parts in contact with the intrusive granite of the ranges have been metamorphosed into marble; partially metamorphosed examples

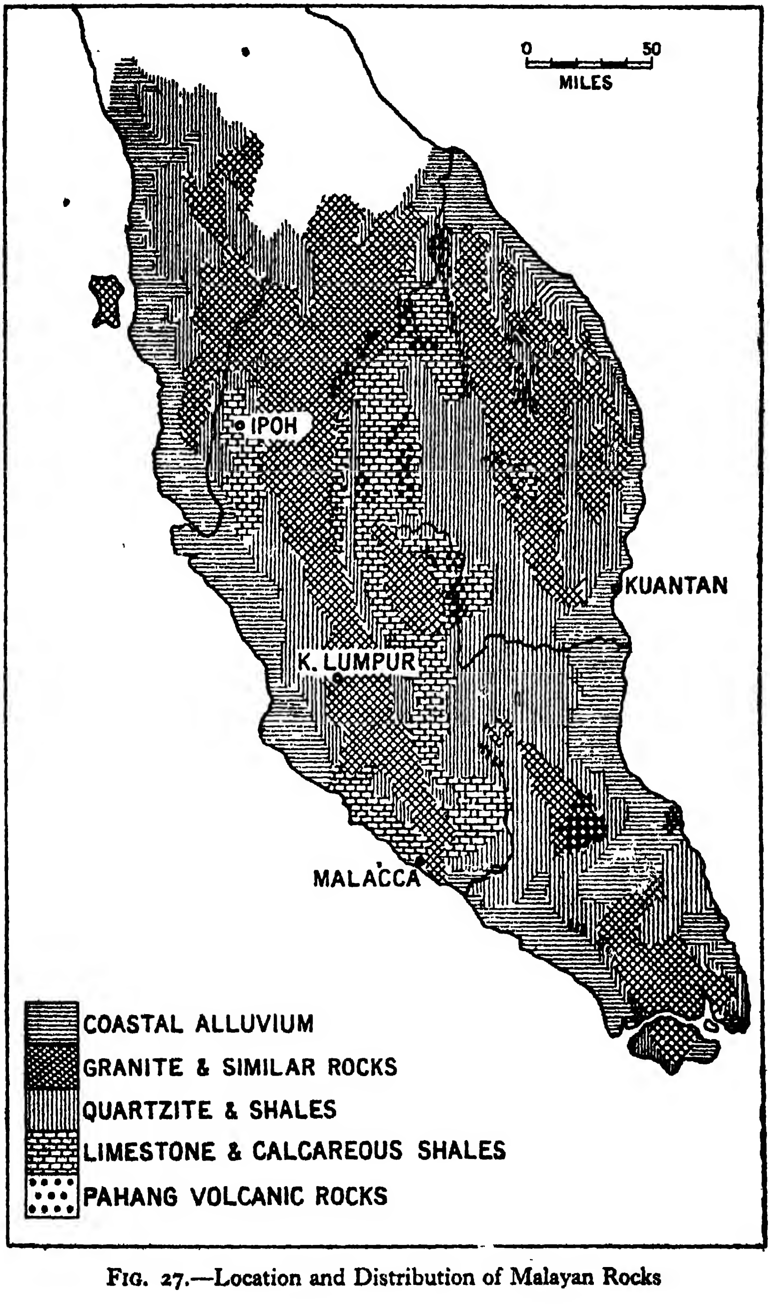

FIG. 27.—Location and Distribution of Malayan Rocks

have resisted weathering and stand up as cliff-like hill masses repeating the solution features of karst landscapes, as in Langkawi, Kinta, Perlis and Kelantan.

(*b*) calcareous shales, containing only thin beds of limestone. They have in places been metamorphosed by contact and pressure into schists, phyllites and slates. Most of this formation has suffered from equatorial weathering and now has low altitudes often blanketed by alluvium; frequently the subsurface limestone continues to dissolve, causing slips of the overlying rocks.

2. Quartzites, conglomerates and shales normally lie upon (1). They form highlands to the north where they often constitute the ranges (as in Tahan) but elsewhere have been partially removed, to remain on the flanks as foothills, standing up because of the resistance of quartzites to equatorial weathering. Jointed and severely folded, the beds often dip steeply, frequently forming steep relief with precipices. The formation contains some purple-green shales, often almost black and with a high carbon content, which quickly weather except where metamorphosed to a glossy schist. Some chert beds, fine textured and flinty, occur among the shales in South Kedah and Selangor.

   A few outcrops of hard quartzite (sandstones whose silica grains have been cemented together by additional silica or by recrystallisation into a resistant mass of interlocking quartz crystals), formed before (1) and (2) and with a few beds of shale, have been proved in small areas of the Langkawis, in North Perlis and near Baling in Kedah. These are the oldest rocks of Malaya but they cause no significant relief differences.

3. The Pahang Volcanic Series is a mixed group of igneous rocks, mainly of volcanic ash, cemented pumice beds and coarse fragments from explosive volcanoes, together with lavas varying from cream or purple rhyolites to dark greenish basaltic rocks. Some of these have metamorphosed into very resistant rocks. This group, whose age is greater than that of Malayan granites, and whose origin has not been fully studied (Scrivenor), is found within the bedding of (1) and (2) and is therefore younger than those formations. It occurs scattered through those parts of Malaya east of the Central Range, except for a few small outcrops west of the Central Range. No volcanoes, active or extinct, have been found in Malaya; the Pahang Volcanic Series is

unrelated to the existing volcanoes of Sumatra and it is difficult to connect them with the long-extinct ones of Borneo which are so far away.

4. Granites, mostly coarsely crystalline intrusive types marked on the geology map variously as syenite, hornblend-granite, granite and granite-porphyry, are generally grey, with large crystals of felspar set among finer crystals of quartz, mica and various dark minerals. Strongly jointed, the granite contains veins of quartz and metallic ores from which derive many of the exploited minerals of Malaya. These granites form the structural framework of Malaya, outcropping as low hills particularly in the south, but also as the major heights of Bintang and Benom (over 6,000 ft.); younger than any of the formations so far described, they assume smooth outlines and gentle curves, emphasised by the thick layer of weathered material which invariably lies upon them.
5. Deposits of soft shale, sandstone and coal occur at Batu Arang in Selangor, on the Siamese border of Perlis, near Kepong and Niyor in Johore and at Enggor in Perak. The coal is a high-grade brown lignite, tending to crumble and with a high moisture content. Its principal working is at Batu Arang where there are easily accessible seams 45 ft. and 25 ft. in thickness (output 1950, 375,000 tons).
6. Great deposits of alluvium, brought by rivers flowing from the other formations, have been spread along the valleys in belts of varying thickness through the foothills, and along the coasts.

The coastal deposits, of dark blue clays containing lenticulate sands and peats, stretch inland for up to 40 miles, as flat swampy ground, at the coast thickening to as much as 400 ft. (as indicated by borings in Selangor). Formed by both river and marine action, these coastal alluvials represent the effects of progressive post-glacial inundation together with the effects of rapid sedimentation among mangrove and swamp vegetation, which seems often to have maintained the coastline despite eustatic change, so that today the general trend is an advance of the coastline seaward.

Inland alluvial belts at the foot of the ranges and along the valleys vary according to rock of origin and the degree of sorting done by rivers and torrents. Clays, sands, gravels, thin peats (old

marsh or lake remains) and thin ironstone bands are common, but adjoining the granite outcrops occur "granite-wash," of white kaolin-like clays containing coarse quartz grains, the first sorting of disintegrating granite. Among the alluvials from metalliferous parent rocks, metallic ores have been segregated by flowing water and from these most Malayan tin derives. The alluvials vary in thickness, probably reflecting differences in erosion rate: in Kinta thicknesses from 60 ft. to 200 ft. have been verified. Partial dissection of older alluvial deposits has left scattered patches of high-level alluvials, remnants of river terraces (Richardson).

CLIMATE

Two factors dominate the Malayan climate:

(*a*) Low latitude, which gives uniformity of high temperatures throughout the year and from place to place. Even at places of high altitude such as the Cameron Highlands in the Central Range, the uniformity is still characteristic though at somewhat lower temperatures. The absence of continuous high altitudes and of large settlements there makes this lowering of temperature of little human significance.

(*b*) The movement of tropical air masses to and fro across the Equator, which causes seasons to depend on wind reversal rather than on temperature changes. In the northern winter, winds from northwesterly points cover the whole peninsula; in the summer, the incidence of wind varies, being southerly towards Singapore and westerly over North Malaya, which makes for minor differences in local climates.

The movement of air masses affects the incidence and distribution of rainfall, variations in which are the chief characteristics of the seasons. Rainfall, however, is not at its peak during any one of these seasons. Maximum rains occur in the Doldrums at the periods between the wind seasons. The belt of equatorial calms is well established over Malaya during April-May and during October-November, bringing rainfall peaks separated from one another by drier (though not dry) seasons when the wind systems are well established (Fig. 31). Thus the rains are largely of instability type, depending on local influences acting upon unstable warm, damp air masses. Hence the importance of aspect, local relief, local convection over bare paddy fields and over bare tin mines, and land and sea breezes in establishing the detailed pattern of rainfall.

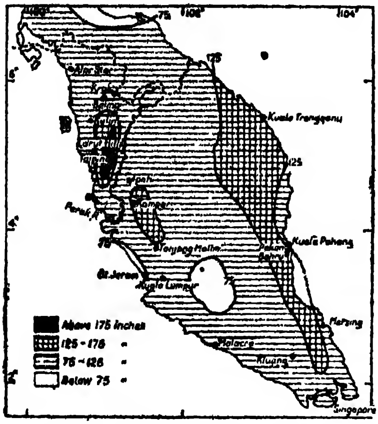

FIG. 28.—Malaya: Total Annual Rainfall

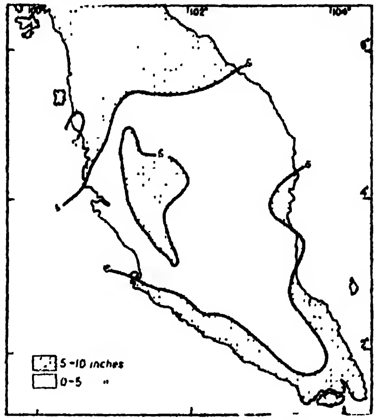

FIG. 29.—Southwest Monsoon: July Rainfall

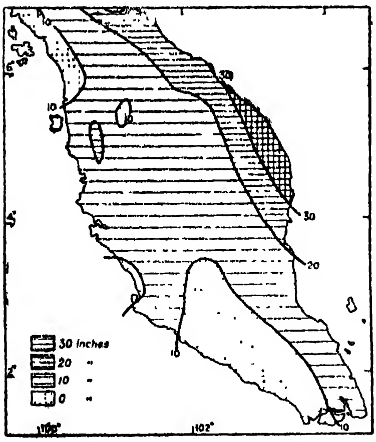

FIG. 30.—Northeast Monsoon: November Rainfall

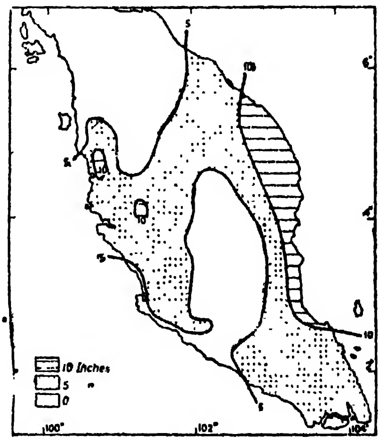

FIG. 31.—February Rainfall

Frequent storms, generally accompanied by lightning, bring very localised rains, typically though by no means always occurring in afternoons, so that the diurnal rhythm (cool clear nights and mornings, hot thundery afternoons) in the weather is often more emphatic than the seasonal rhythm of change.

The seasons are: (1) Northeast Monsoon, from late October to the end of March, when strong winds blow from the South China Sea, bringing heavy rain and low cloud to the east coast and to the

eastern side of mountains, while elsewhere winds are lighter and the rainfall less (Fig. 30). (2) Southwest Monsoon, from the beginning of June to September, bringing generally light winds and a drier period (Fig. 29). (3) The Doldrums or transitional seasons of April-May and October-November, with light variable winds, very heavy rain, much cloud and violent electric storms.

During the Southwest Monsoon small intense storms called "Sumatras" occasionally move towards the Malacca-Singapore coast from the Malacca Strait. They are line-squalls in character, bringing violent winds and heavy rains for a few hours. These storms rapidly lose force after crossing the coast.

Rainfall

Malaya's rain falls mainly in torrential showers (often an inch in an hour) and during the late afternoon, though the incidence tends to be after midnight on the east during the Northeast Monsoon and on the west during the Southwest Monsoon. The total rainfall (Fig. 28) varies widely from year to year, a reflection of its origin in instability storms, and at any part of the year heavy rains and dry spells are equally possible. To the west, rainfall averages are high from October to January and least in July or February. To the north August to October brings intense rains and December to February is distinctly dry. To the east October to December brings heaviest rain, with minimum in February (Fig. 31). Severe flooding often results from the very heavy showers which may bring 15 inches in one day; 17 inches in 8 hours have been recorded in Penang.

The east coast is a belt where high annual rainfalls occur (mostly over 125 in. per annum) but the localities of highest rainfall are the Larut Hills of the Bintang Range (over 200 in. per annum) and that part of the Central Range between Kampar and Tanjong Malim (over 150 in. per annum). The driest district is the sheltered one just southeast of the Central Range, centring on Kuala Pilah (below 75 in. per annum).

Humidity for most of the year remains high and, while the relative figure for daytime may fall to 65 per cent, the wet bulb is usually above 75° F. for most days, nights and seasons, which produces enervating conditions. In these circumstances, human comfort depends on the cooling effect of evaporating perspiration and this, in turn, on movement of air, so that on shores and windy

places the enervating effect is not strong, though it may become overpowering in closed or sheltered places.

AVERAGE MONTHLY RAINFALLS (in inches)

	Aver. heavy rain days	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Alor Star ..	58	1.7	1.2	5.3	10.5	8 6	7.5	6.6	10.6	10.2	13.7	8.3	6.2	90.4
Trengganu ..	59	9.2	3.4	7.3	4.6	4.7	5.1	6.2	7.0	5.8	14.7	27.2	24.7	119.9
Cameron Highlands ..	68	6.0	5.1	6.8	12.4	10.7	5.1	3.7	7.8	8 9	13.1	12.3	9.8	101.7
Kuala Lipis ..	61	10.1	3.5	6.9	8.0	8.4	5.8	5.1	6.6	7.7	11.5	11.8	9.8	95.2
Kuala Lumpur	62	6.6	6.1	8.8	10.5	8.5	4.9	4.3	6.3	7.3	11.1	9.9	9.7	94.0
Kluang ..	55	8.6	4.1	8.7	9.9	10.0	6.5	3.9	6.3	6.5	9.3	10.1	8.4	92.3
Singapore ..	58	9.9	6.9	7.6	7.4	6.8	6.8	6.7	7.7	7.0	8.2	10.0	10.2	95.2

(By "heavy rain days" is meant "days receiving 0.5 inch and over")

More significant from the agricultural point of view is the cloud cover, upon the absence of which largely depends the ripening of fruits and paddy. Clouds, mostly cumulus, vary very much during the course of any one day, though October and November are decidedly the cloudiest months and February the clearest. Over the interior and the west, January to March is a period of moderately clear skies. At all times Singapore and the mountains have denser and more prolonged cloud cover. In part the rainfall map reflects the cloud cover which is significantly small over the rice areas of Kelantan and Kuala Pilah.

Drainage System

High rainfall and low evaporation cause Malayan rivers to have great volume relative to their length or catchment areas, they contain more organic solubles and colloidals than solids, they change rapidly in volume within hours or days and so encourage levees. While the drainage system is of great antiquity and far advanced in development, there are discordances in Malayan river profiles which relate to a remoter history, the more recent physical history (Fig. 17) being one of progressive inundation which has overflattened the lower profiles in relation to the upper profiles. Changes of landscape due to solution of limestone massifs have also caused drainage readjustments. The rising sea level has not caused ria estuaries owing to rapid sedimentation, but rivers have not developed normal delta form because strong seasonal onshore winds spread the sediment as spits and lines of offshore drift, flattening the plan of deltas on their seaward side.

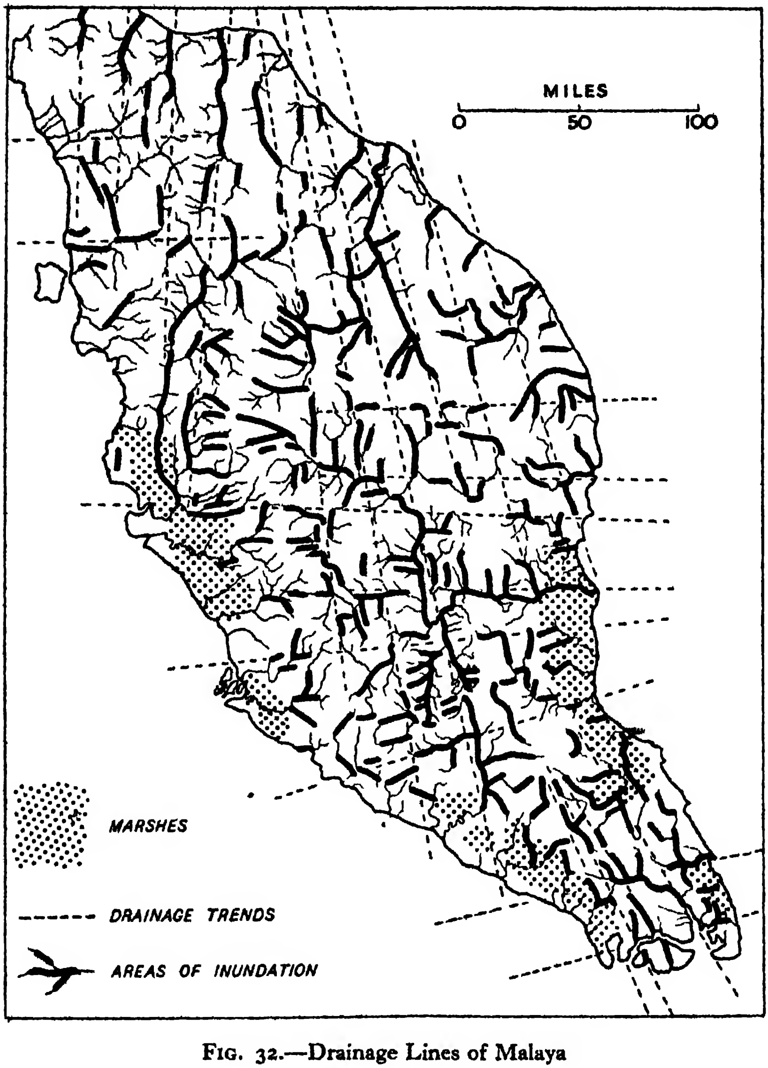

FIG. 32.—Drainage Lines of Malaya

The plan of Malayan rivers (Fig. 32) is a product of several influences, each of which varies in proportion from place to place:

(*a*) The tectonic pattern of the ranges tends to produce longitudinal streams running on broad meridional lines through the strike-vales. This is apparent in the Kelantan, Perak and Johore rivers and in the middle course of the Pahang.

(b) The orographic influence produces streams on latitudinal lines consequent to the slopes of the ranges and sometimes breaking through the adjoining ranges in cluse. Under this influence the Upper Pahang tributaries, for example, flow east.

(c) The continental submergence has induced premature precipitation upstream and created meanders and vague drainage far inland.

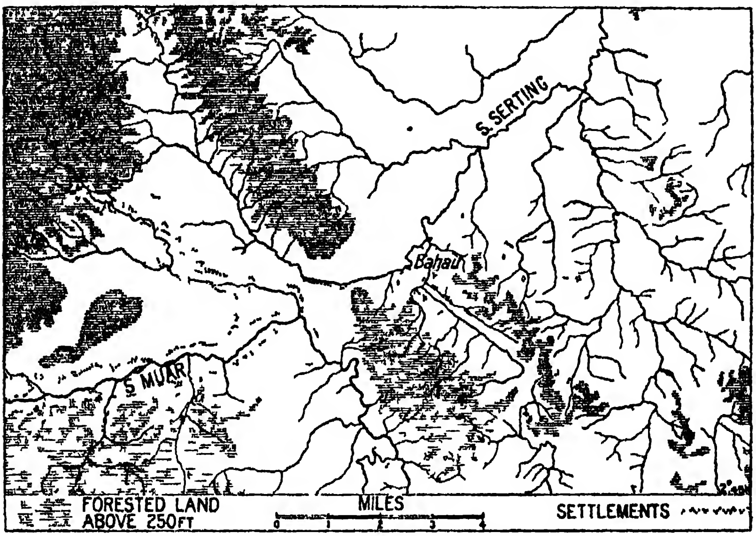

FIG. 33 —River Capture in the Upper Muar Area

Where (a) and (b) predominate, as in most of Central and North Malaya, the river pattern becomes trellis-like with broad marshes in the meridional sections and sharper relief at the transverse courses in the cluse. Senile versions of the pattern familiar in uniclinal structures show fairly symmetrically on each side of the ranges. Towards the south, the factor (c) is dominant with some erosional competition between the Malacca Strait and South China Sea drainage systems; the upper Muar shows signs of capture of the latter by the former (Fig. 33). Capturing of upper courses and shifts of lower courses are widespread, as in the Kinta and Pahang rivers.

In the limestone zones a fourth influence comes into play: the drainage originally developed on the limestone rapidly changes as solution removes the formation, which factor, for example, has

re-aligned the Kinta streams from being tributaries of the River Pari to being Perak tributaries, as at present (Fig. 37).

Soils

Rocks differ in their reaction to equatorial weathering, which tends to be one of laterisation, though there are considerable areas of podsolisation which produces bleached grey or white subsoils that have complicated the interpretation of high level soils found in many places.

(*a*) On granite, weathering first breaks down the felspar crystals to kaolin, leading to a mixture of fine clay and coarse sand which may be 50 ft. thick. Squared blocks of fissured granite disintegrate into rounded boulders within the clay-sand mass. High precipitation aids slipping and slumping of this weathered surface so that bare slopes of granite appear in parts of Malaya.

(*b*) Quartzites and conglomerates weather chiefly into loose sands and pebbly gravels, generally not weathered so deeply as in granite. Chert rapidly bleaches into dull angular fragments. Ease of drainage through such loose materials appears to encourage podsolisation rather than laterisation (Glinka).

(*c*) On shales, slates, schists and phyllites the laminated structure breaks down easily into a soft tenacious clay, often containing mica flakes. The carbon compounds in these rocks bleach white. The clay may take on a wide range of colours, yellow, brown, green or blue. Core boulders of fresh rock are found within this weathered material and laterised ironstone concretions commonly occur close to the surface, often forming a surface athwart the structural lines.

(*d*) Limestone weathers by solution and little residuum is left except from the calcareous shales. Pinnacles and knife-edge ridges, the normal superficial effects of limestone undergoing solution, have been preserved beneath the alluvials of the Kinta Valley which also conceal old drainage channels, incised into the limestone. Solution still goes on under the alluvial blanket which is constantly subsiding. Cave systems occur in all stages of development from fissures to enclosed basins (*wangs*) formed from collapsed areas, and stalactites are found everywhere in association with the caves.

(*e*) Most rocks of the Pahang Volcanic Series resist weathering and stand up as bare outcrops with only an inch or two of bleached

surface like a rind above the original rock. Rhyolites, however, weather down into silts and volcanic explosive agglomerates into loose boulders. Certain local zones of weathered basic igneous rocks produce fertile soils though these are not particularly significant in Malaya owing to their inland location and the absence of adequate incentive to exploit fully the soil resources (Scrivenor).

(*f*) Quartz veins, which run through and beyond the granites, resist weathering and may persist as lines of broken crystals within masses of weathered material. Where the quartz is continuous and thick, as near the Klang Gates, it stands out as a topographic feature.

Within the valleys and marshes and along the coasts, soils are transported, consisting of fine sticky clays with a high vegetal content; these are depositories of river-borne topsoil from the uplands. Outside these areas soils have mostly developed *in situ* to produce only a few inches of humus-bearing topsoil overlying a thick laterised subsoil. The agricultural value of the *in situ* soils is invariably very low; that of the transported soils varies enormously, a fertile loam often deriving from the calcareous shales. The major fertility factor is less the soil itself and more the location of the watertable. Cleared, drained and cultivated, the transported soils of the estuarial zones represent the accumulation of fertile elements from the whole interior and maintain production for long periods without noticeable deterioration, largely because at this stage and at such low levels weathering does not leach them. Elsewhere solefluction, slipping and slumping combine to hasten the removal of both top and subsoils, aided by the high proportion of water within the ground and by the characteristic panned structure of laterised soils which are very fully developed in Malaya where both climate and tectonic history have together induced advanced laterisation.

The flow of subsoil water varies considerably, though under most areas such water is held colloidally rather than interstitially, so that wells are only rarely of the percolation type. Large areas of the Malayan surface are so waterlogged that the watertable lies only an inch or so from the surface. Local artesian conditions have been met within the lenticular alluvials along the coast. Most water supply, however, is from surface sources and wells accumulate surface run-off rather than fill by percolation from below. Hot springs near Malacca and Kuala Lumpur and in Perak

have low pressure issues of water at about 100° F.; these are probably from great depth, deriving their heat from pressures rather than from vulcanism and for this reason are known technically as "juvenile" waters.

Forest Landscape

While certain types of Malayan natural vegetation occupy too small an area to be easily mapped, they merit special consideration because they stand in just those marginal zones where population concentrates and because the Malayan natural landscape is more sharply differentiated by the forest types than it is by any other single factor. To some extent the forest types relate to the relief and location so that a dual tag aptly describes them.

The Casuarina Beach Woodlands.—An almost continuous casuarina fringe some 60 ft. broad stretches just above high water level and above the level of fresh-water swamp, along the coast from Trengganu to Johore and in patches along the west coast. These trees, often 80 ft. tall, have needle leaves which fall to make a bed, obliterating other vegetation, though other gnarled trees, like *penaga laut* (Calophyllum) and *ketapeng* (Terminalia Catappa) may accompany it. The tree establishes itself quickly upon exposures of marine sands and dunes, often acting as pioneer for mangrove. Behind it, inland, usually stretches a few hundred yards of scrub, tropical grass (*lalang*, Imperator cylindrica) and Straits rhododendron (Melastoma). This beach forest provides some timber for building fishing boats.

Mangrove Sea-Swamp Forest.—Forming a seaward belt from Kedah to Singapore, the mangrove forest ranges from 50 yds. to 12 miles in width and extends farther inland along rivers. Within it, river estuaries provide waterways and sometimes the forest subdivides into islands with deep channels between them, as round Port Swettenham. These mangrove swamps develop from river muds, often infilling lagoon-like spaces between offshore bars of marine sands thrown up persistently by Malacca Straits currents. They shelve gently on the seaward side so that even small seagoing boats must keep hundreds of yards from shore at low tide. Mangrove banks become convex, the slightly higher part being less frequently and less deeply inundated, which exercises a selection of species. Deposition quickly raises the surface level a process aided by burrowing prawns (Thalassina).

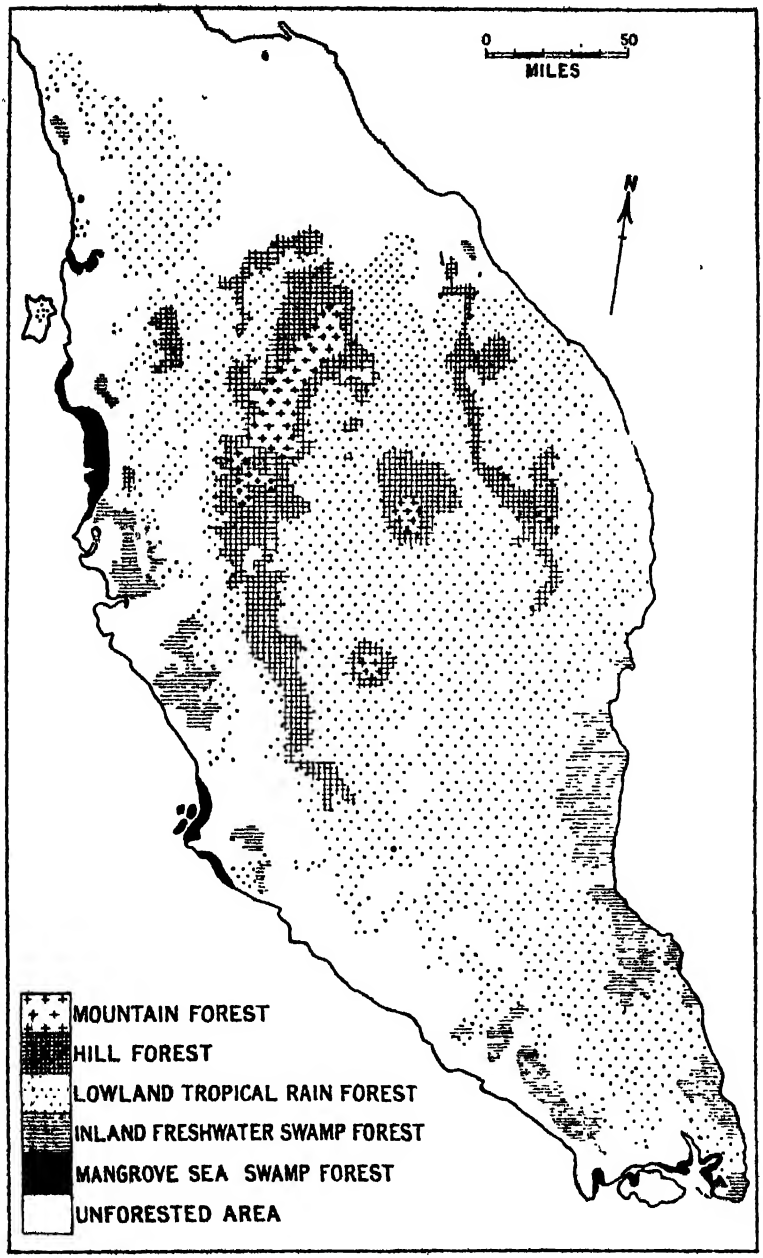

FIG. 34.—Forest Types of Malaya

The trees are uniform dense growths averaging 40 ft. high, with dark shining foliage. The *Api-api* (Avicennia), with typical greyish leaves, is an early coloniser, capable of establishing itself upon banks exposed by the sea only for a few days; it binds and builds up the surface, making possible the setting of other species. Fireflies frequent this tree, which is traditionally a guide to sailors. Behind the *Api-api* in situation, and succeeding it in progression, come *Bakau* (Rhizophora), and *Lenggadai* (Bruguiera). Away from the estuaries in Selangor, Perak and Province Wellesley there are acres of swampy scrub enclosed by small bunds built to exclude tides from farmlands and often the sign of land which has gone out of cultivation.

Mangrove forests of the east coast are confined to estuaries and colonise somewhat differently upon sandspits driven southward from the river mouth. These banks are colonised by casuarinas and then the creek or lagoon behind is converted into mangrove swamp and gradually filled by tides through some breach in the sandspit. Remnants of successive spits and mangrove swamps may be traced inland for several miles in some places and the swamps at a later stage frequently become lines of paddy fields. Similar successions may be met in Kedah.

Mangrove covers over 460 square miles and is well worked over for firewood, charcoal and poles for which the trees are particularly suited. Some parts of the mangrove zone are well peopled. Villages in them may have several thousand people in settlements built on piles and lapped by the tides, or in lines on old beach sands. Fishing, fish drying, pig keeping and crocodile hunting (for the skins) are the human activities in mangrove settlements, which usually avoid sandy stretches of the west coast owing to the high incidence of malaria and sandfly fever. That pigs are so frequently kept is sign that these villages are often non-Muslim and the people more primitive than Malays.

Lines of nipa, nibong (Oncosperma) and pandanus develop along estuaries where water is fresher; the nipa is highly valued for thatching and the pandanus leaves are woven into sleeping mats and bags.

Inland Freshwater Swamp Forest.—The recent history of rising sea level, together with the torrential rains of today, cause the extensive alluvial lowlands to be frequently under water, to form Inland Freshwater Swamp Forest. In these places the soil is a viscous mud

covered with peat which may, as in Kuala Selangor, be as thick as 30 ft., the greater thicknesses normally being well inland. While the trees of this Freshwater Swamp Forest are below the Malayan average for height, the sodden ground has a thick undergrowth mainly of palms, pandanus and thorny plants, making the forest almost impenetrable. *Lopak* is the local name for those marginal areas which are occasionally rather than regularly flooded. *Permatang* are low ridges of slightly drier land running through the swamp, probably old levees or beach lines. In Kedah and Perlis the swamps contain considerable pure stands of *gelam* (Melaleuca) which can grow in water up to 3 ft. deep. The types of tree are relatively few though they include commercial trees which remain untouched because of inaccessibility over the swamp ground.

Lowland Tropical Rain Forest.—This forest type in Malaya differs little from the one usual to similar areas of Southeast Asia (see Chapter 4). It persists from the coastal plains to heights of 2,000 ft. and occupies 60 per cent of the peninsula. While there are thorny types of undergrowth, such as *bertam* (Eugeissona), rattans (climbing palms) and *kelubi* (Zalacca), access is not generally difficult, which makes the extraction of *chengal*, *balau*, *kapur*, *keruing* and *meranti*, the chief Malayan timber trees, commercially practicable, though difficulties of haulage, extraction and labour shortage prevent extensive exploitation. These timbers are used domestically, yet Malaya is a net importer of timbers. The collection of gums and similar products from wild trees has always gone on, but has rarely exceeded a third of a million dollars annually; of this *jelutong* for chewing gum was always the greatest single item.

Malayan timbers are:

1. *Chengal* (Balanocarpus), a very strong, hard, heavy structural timber.
2. *Balau* (Shorea) similar to, but less durable than *chengal*.
3. *Merbau* (Afzelia) strong, hard and heavy, for internal construction because it resists white ants although liable to quick decay.
4. *Kapur* (Dryobalanops), strong, moderately hard, durable, for buildings; especially abundant in Trengganu and East Johore.
5. *Keruing* (thirty species of Dipteroca ɔus), strong, moderately durable, shrinks greatly, very abundant but needs treating unless used for covered constructions; mainly extracted from Johore.
6. *Meranti* (several types of Shorca), generally reddish, moderately

hard, not very durable; for light or temporary constructions or cheap furniture.

Secondary Forest.—This has no natural location since it originates from clearings man-made, from forest fires, and from abandoned farms. Known in Malaya and the Indies as *belukar*, it is a forest type whose stages of growth vary enormously from initial long tropical grasses (*lalang*) to a forest not clearly distinguishable from lowland forest. Patches of it may be exclusively *resam* (impenetrable climbing bracken), but it is generally mixed with heavy undergrowth.

It is commonest near *kampongs* and in northeast Kedah where jungle tribes have almost over-worked the forest with their temporary clearings. *Belukar* has no commercial use, apart from the extraction of a little bamboo; it is, however, a heritage of other uses.

Hill Forest.—This is a type of Tropical Rain Forest which is adapted to the slightly different weather of the hills. It develops on uplands and ridges from 2,000 to 4,000 ft. high. Most *keruing* (Dipterocarpus) disappear at this altitude. The *serava*, a grey-leaved tree, is prominent, together with the thorny *bertam* palm. Nothing of value comes from these forests though they are threaded by tracks of many wandering tribes.

Mountain Forest.—Above 4,000 ft. the mountain forest of Malaya is that normal to similar heights in Southeast Asia (see Chapter 4), being a transition varying from mountain oak forest (Pasania) at lower altitudes to xerophytic scrub at greater altitudes. The only tree of commercial use is "mountain oak" for local firewood and hill station structures.

Chapter Seven

THE CULTURAL LANDSCAPE OF MALAYA

THE Malayan cultural landscape as a whole has been only lightly modified (on about 33 per cent of the total area) by human activities and both the intensities and the age of the modifications are dominated by two distinct objectives; to obtain food, and to obtain money.

Activities associated with obtaining food are still the chief concern of indigenous peoples, whose ways, traditions and patterns of settlement and distribution have been much the same for centuries and are closely integrated in detail with the subtle variations of local environment. On the other hand, those parts of the landscape devoted to obtaining money, by the sale and export of produce, are recent innovations by foreigners whose ways and patterns of settlement relate more to conditions overseas than to the Malayan landscape. These latter areas show the influence of recent diffusions of modern technique and modern economic organisation, immaturely modified to the setting though varying in impact upon and interrelation with the older cultural landscape forms. Thus the cultural landscape may be divided into two, the food producing and the money producing; to a certain extent there are marginal overlaps between these landscape types.

THE LANDSCAPE OF FOOD PRODUCTION

The large-scale food-producing activities in Malaya are rice farming and fishing. All are overwhelmingly Malay activities, so that traditional Malay houses (stilted, thatched wooden huts), costume (loose skirtlike *sarong* and black fezlike *songkok*) and cultural centres (mosques) characterise the associated landscapes in degrees varying with the prosperity of the region and with its isolation.

Fishing.—While fishing is most developed and specialised on the basis of sea fishing, all rivers, streams and even canals are fished for local use, and fish form the second staple in the Malay diet. Along the East Coast, villages are often nearly entirely devoted to fishing

and to drying the fish into forms suitable for transport in this hot climate; round Pangkor Island and the Dindings there are similar specialisations. In those places the fishing village occupies a part of the coast fairly sheltered from the violence of the sea during the worst monsoon storms, and its houses are often partly hidden under coconut palms, grown as adjunct to fishing and as source of cooking oil. Malayan fishing is inshore work using drift, seine and lift nets and lines in waters less than 20 miles from the coast. In the shallow fringes of the calmer West Coast thousands of long screens of bamboo stakes are built in the water to lead the fish into traps; these are mainly used by Chinese fishermen. Fishing tends to be an exclusive occupation, other food needs of fishing families being obtained by sales of fish; on the East Coast, where November to March is a closed season due to the violent weather, fishermen may also be paddy farmers or coconut smallholders. The frequence of coastal swamps tends to isolate fishing villages from the interior and their communications are normally by water, except in Malacca and on the Perak coast where there are major interior markets for fresh fish chilled with ice and transported by road.

The chief fish edible in Malaya are, in order of weight caught, *Kembong* or mackerel (Scomber) especially from the Dindings; *Bilis* or whitebait (Stolephorus), chiefly from Trengganu; *Udang* or prawns (Peneus), from the West Coast; *Tamban* or sprats (Clupea) from northern coasts; *Selar* (*Selayang*) or horse mackerel (Caranx) mainly from the East Coast; *Parang* or Dorab (Chirocentrus) from the southern coasts; *Delah* or seabream (Caesio), coming to Singapore from deep sea fishing among islands farther south than Malaya.

In 1950 the total catch amounted to 100,000 tons, of which nearly two-thirds was from the West Coast where fishing is more commercialised; on the East Coast much is consumed fresh on the spot and goes unrecorded. About 65,000 persons reported themselves employed in fishing in the 1947 census.

Rice Farming.—Whether or not the theory that Malays were originally seafarers, fishermen and sailors can be maintained, they have in fact become the paddy-farmers of the Peninsula. Of some six million acres of agricultural land, about three-quarters of a million acres normally carry rice, the chief states concerned being Kedah, Kelantan and Perak in that order; these three states contain

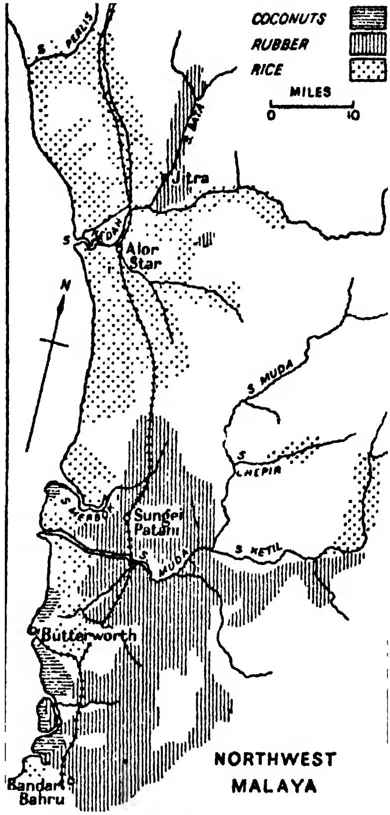

FIG. 35.—Land Use in Perlis, Kedah and Province Wellesley

over two-thirds of the Malayan paddyfields. At least 90 per cent of Malayan paddy is wet, so that hill or dry paddy contributes negligibly to the landscape and the production. Dry paddy is sown to a small extent in the small clearings of shifting cultivation and also as a catch crop on land being newly cleared and prepared for other agricultural uses. On the land utilisation map only wet paddy is sufficiently large to mark, occupying only a small surface of Malaya as a whole and best examined on the regional maps of land use (Figs. 35–43).

Wet paddy depends on water control which in Malaya varies from primitive arrangements for holding or restraining local rainwater run-off to ingenious Malay devices for directing river water, and to modern engineering schemes. Kedah, Province Wellesley, Krian in Perak, and Kelantan have extensive and continuous areas under rice, all of them in the lower deltaic zones of large streams. Elsewhere units of paddy-land tend to be small, stretched along the flood plains of the larger rivers, the Perak and Pahang (Fig. 42), and in thin ribbons among hill valleys (Fig. 38). Scarcely any wet paddy grows above the 50 ft. level anywhere in Malaya. In the coastal belts of Kelantan, Trengganu and in parts of Province Wellesley, the rice is in innumerable small areas mostly of the order 10 acres, lying between the sandy ridges of old spits which once enclosed mangrove creeks and lagoons. These are areas of coastal advance under continual river deposition, moulded by marine currents. During dry periods, the fields in such areas

receive brackish water from seawater percolating inland through old beach sands as the water-table lowers; bunds of 2 ft. are built on the tidal side of these fields to reduce this risk. Occasional flooding by dilute seawater in some of these areas seems not to affect agriculture since the heavy torrents of fresh rainwater later remove the brackish water from the surface.

These paddylands provide on the Malayan landscape the only open plains without trees. There is rarely any settlement within them, houses and villages being characteristically marginal, seeking levels just high enough to be free from normal flood risk. The houses are, in addition, stilted to stand some 3 ft. from the ground. This stilting of houses has become a tradition, based no doubt on present flood risk, security from wild animals, coolness, and possibly the old Malay association with coastal and estuarial sites subject to tides. Across all paddyland run shallow control ditches and canals lined by bunds which become tracks of movement and sites for settlement. Malay-built canals have been dug to 4 ft. depth and 18 ft. width, the bunds being perhaps 3 ft. high, 10 ft. broad and unsurfaced. Heads of water in the canals are often formed by dams of faggots and boulders. They are filter-dams in the sense that they are to some extent permeable, allowing a gentle trickle of water through and over the dam. These are easily built, quickly removed during unexpected floods and they do not significantly diminish the silt load. Modern canals constructed by western engineers are similar in size but the bund on one side is usually broader and carefully surfaced as a track. In these canals the dams are generally permanent cement structures, often with sluices at the bottom. By stopping water completely they tend to retain the silt content and the violent outflow from the sluices has in some cases bitten deeply into the valley below the dam, causing progressive lowering of the water-table in the adjoining fields, which thereafter become more critically dependent on irrigation rather than on natural water.

Fields are subdivided with small bunds 9 in. high, to mark property limits and to facilitate water control. They give a shallow-stepped or terraced appearance though it is rare to have more than a few inches difference of level between adjoining fields. At most stages of paddy growth these fields are flooded; in the off season they bake hard and the bare ground under the sunlight works up to very much higher temperatures than customary

elsewhere, a factor which may act as a "trigger" in local convectional storms.

In Kedah, Perlis, Kelantan, Trengganu and most of Malacca, paddy stands growing in the fields during the wet phases of the year from September to January. Where seasonal water is ample, as in Kedah, even in June planting may take place. Reaping, by hand methods, generally cutting head by head, goes on variously from January to March, after which the ground lies fallow. Where there is little noticeable rainfall rhythm, planting depends on irrigation from rivers whose flood peaks harmonise with heavy rains in a remoter part of the country; planting is then timed by official announcements based on information about heavy rains round the headwaters. Few areas cultivate more than one crop of rice a year, the local explanation being that the ground and the shortage of water will not permit a second crop. Over the paddy areas, roads invariably stand upon embankments above normal flood levels.

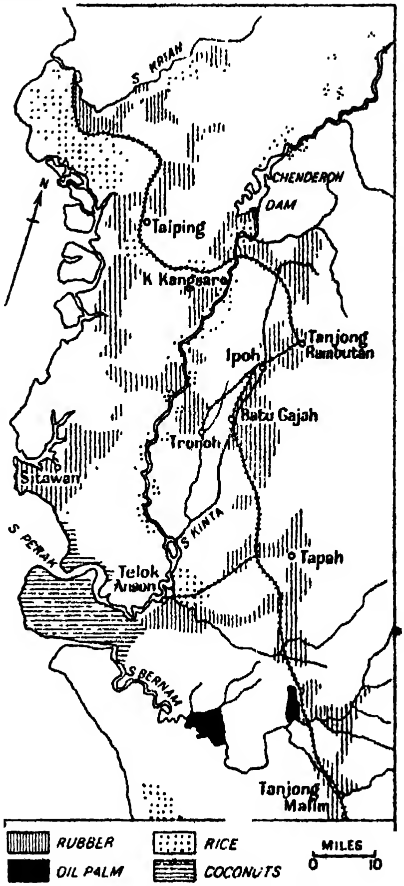

FIG. 36.—Land Use in Perak

Considerable variation in the rhythm of cultivation may be noted from district to district, depending upon the incidence of floods either from torrential rains or from the river. While these rhythms of activity relate to solar rhythm affecting the rainfall, the local calendar is lunar, and the festivals associated with it are not closely connected with the rhythm of agricultural life of the seasons, a discordance matched also by the Muslim religious

festivals which relate more to Middle East events than to those of Southeast Asia. Geographically, the persistence of seasonal rhythms in food agriculture is an interesting contrast with the ill-defined character of local seasons. Despite the absence of strongly marked seasons, leaving an equable condition which better matches a yam agricultural system, the average yields of Malayan paddy (some 1,033 lbs. of cleaned rice per acre for 1946–50) are higher than those of most Southeast Asia territories.

CYCLE OF MALAYAN PADDY FARMING (1946–47)

	Kedah	*Kelantan and most E. coast*	*Inner Pahang (Temerloh)*	*Malacca*	*Negri Sembilan*
Preparing fields ..	Early Aug.	Early Aug.	End Feb.	Early July	Early March
Setting seedbeds ..	Mid Aug.	Mid Aug.	Mid March	Mid July	Late March
Transplanting ..	Early Oct.	Early Oct. possibly Dec.	Early May	Mid Aug.	Mid May
Harvesting	Early Feb.	End Mar.	Oct.	End Jan.	Late Oct.
Expectation of heaviest rain	Oct.	Dec.	Dec.	July	Mar.
Length of time in ground	7–8 months	8–9 months	8–9 months	7–8 months	6–8 months

The total Malayan rice production is normally about one-third of a million tons, which is roughly one-third of the population's requirements. Much of Malayan rice is locally consumed by the Malay farmers and scarcely enters the trading system. Often the milling and processing of paddy is done on the farms by hand methods. Because these methods suit only small quantities at one time, paddy is often stored in the husk (it keeps better that way) in large thatched bins of woven palm leaves standing upon rat-proof legs in front of the farmhouse. A few official power mills have been set up to encourage large-scale rice production in the more extensive areas such as Kedah, Perlis and Perak but there are very few huge mills such as those of the Burma-Siam-Indo-china rice producing landscapes.

Because buffaloes are used to pull the ploughs, they are common in all paddy areas, where Siamese-type oxen may also be used. Over two-thirds of Malaya's oxen and buffaloes are distributed in the paddy areas. Inadequate local fodder restricts these animals in number and size and they play little part in the economy of farming apart from haulage; they graze on paddyland after harvesting and upon young shoots of tropical grasses.

Settlement in the paddy areas is in villages (*kampongs*) of Malay houses standing a little apart from each other and surrounded by a few coconut or fruit trees which both conceal and shade the

houses. There is little nucleation in the European sense; not even the mosque acts as focus to the house groups and the typical long string of houses may have different place names in different parts of the same line. Settlements of this open type have clearly no defensive outlook and the lines of houses run (*a*) along the edges of paddylands, so that the kampong has the form of the contour, (*b*) along bunds or canals, in straight lines, (*c*) along roads, mostly linear but occasionally cruciform, where roads cross. To some extent the dispersed settlement form offsets and makes innocuous the absence of any sanitation and the dependence for potable water on local streams or canals.

Few supplementary food crops are grown by the Malay farmer: he plants small patches of coconut for his cooking oil and illuminant, a few areca palms and some fruits, but vegetables are neither extensively grown nor prominent in his diet.

The Landscape of Production for Cash

Whereas food production is an indigenous activity, production for money is an innovation by foreigners upon parts of the Malayan surface which previously had had no production value. Thus the two forms of production have been able to go on side by side with relatively little mutual interaction in techniques, in peoples or in tradition.

Two distinct types of landscape have evolved with the object of production for cash sales—one an agriculture for commerce, the other mining. The former is mainly concerned with rubber and the latter with tin, though there are variants.

(*a*) *Cash Agriculture*

Rubber.—Over the last fifty years, the rubber tree has become the most important crop in Malaya both by area (about 3½ million acres out of a total agricultural area of 6 million acres), in value, and in numbers of people directly employed (.5 million out of a total 1.2 million agricultural workers in 1947 census). In post-war years all figures except those for area have changed without changing the outstanding position of rubber farming.

Until the introduction of *Hevea Braziliensis* as a British experiment over several years from 1879, Malaya had never been concerned even with collecting wild rubber and no local latex-producing plant had attracted major interest.

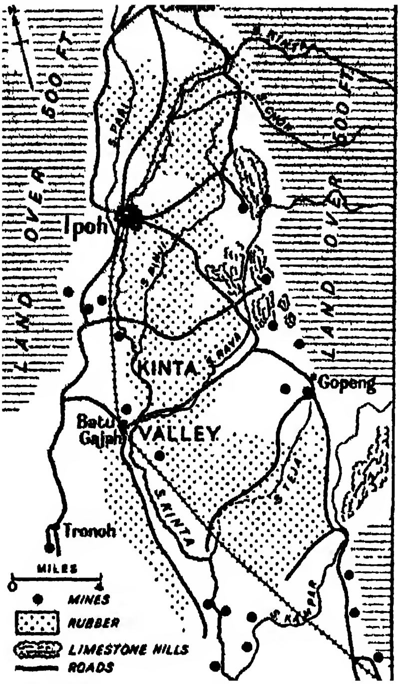

FIG. 37.—Land Use in the Kinta Valley

The *Hevea* was particularly suited to the poor lateritic soils and the climate of Malaya, both of which resemble those in the Amazon Valley, and its introduction met several needs—the need for an agriculture to open up Malaya's virgin forests, the growing needs of the electrical industries in Britain, and the new needs for rubber tyres as the car industry developed in the United States and Europe. It was, however, a tree requiring at least seven years to reach maturity which, together with the heavy initial labour costs of jungle clearing and of recurrent maintenance costs during growth, implied substantial financial backing. Hence the rubber plantation became a highly capitalised, company-promoted operation of long-term planning, something as foreign to Malaya as the new tree and the people who worked to cultivate it. As a result, the cultivation of rubber represents an outstanding example of large-scale human intervention in plant geography so that Malaya and Southeast Asia are now more linked with the *Hevea* than is the Amazon Forest which was its home, and large portions of Malayan land have been converted from its natural heterogeneous forest to a homogeneous forest of rubber trees with an artificially limited undergrowth retained as erosion control.

At various times other crops were tried in Malaya to establish commercial agriculture—gambier, coffee, tea, sugar—to be virtually abandoned for different reasons of soil poverty, labour scarcity and competitive production elsewhere. Only tea continues as a commercial crop.

Originally all rubber was "clean-weeded," kept free from undergrowth in the manner of orchards in temperate latitudes.

This caused rapid erosion of topsoil by torrential rains and led to experiments to control and improve the soil. It culminated in the technique of letting undergrowth develop as a soil protector, a device hastened by neglect during the Japanese Occupation, so that most plantations now have considerable scrub undergrowth through which run paths for the labourers to reach each tree.

When the rubber-growing became well established as a highly capitalised agriculture run by plantations normally covering about 2,000 acres each, Asiatic smallholders took up the crop in units mostly of less than 100 acres. These smallholdings are of two types: larger ones organised as miniatures of the estates, and smaller ones run by paddy-farmers or fishermen as an adjunct to their food producing activities and drawing them, to a degree varying with the price of rubber, into the system of production for cash. More than 39 per cent of rubber is now in this smallholding category, which produced 46 per cent of Malayan rubber in 1950.

While rubber fits the Malayan ecology by being almost constantly productive through the year and continuously growing and producing over many years, it needs an equally continuous labour supply for the tapping and collection routines. In this sense the rubber plantation by its regularity of rhythm throughout the year resembles the dairy farm. On an average one worker is needed for each six acres though this proportion is less where workers contract to tap by area rather than by time and varies considerably from estate to estate. These workers are at wages, and purchase their food from distant producers, a factor which operates to keep rubber costs relatively inflexible except in the case of smallholders who can grow food to feed themselves and thereby lessen their immediate dependence on rubber prices.

But the total labour force needed for rubber growing is clearly heavy. There was no labour force in Malaya, so that the whole of the rubber system came to depend upon imported labour, partly Indian, partly Chinese. By 1948, 2.0 million acres of rubber estate employed 290,000 workers of whom 52 per cent were Indian and 29 per cent Chinese. These live in small squalid hamlets scattered within the plantation which has one central nucleus round the factory where the latex is coagulated, formed into sheets and smoke-dried for sale off the plantation. Only in a few large scientific estates such as those pioneered by Dunlops, has it

become the practice to move liquid latex from the plantation to the ports for shipment in that form to processors overseas. Except at the factory, the workers' settlements have every sign of their unattached, floating lives; their quarters are almost makeshift, they have tolerated monotony and crudity to accumulate money to set them up elsewhere. When foreign labourers immigrate, they often go to the estates as their first experience of work in Malaya and they generally graduate to other less austere types of employment.

The factory is the managerial centre, but is no more integrated to the population and the setting than the tappers' hamlets, because the managerial group is mostly transitory as well. Everything on the landscape tends to be impermanent, crude, unshapely and artificial, without any mature cultural or communal living at all. Thus the cultural landscape of a rubber estate bears little resemblance in its structure to that of Europe where the technicians came from, or to that of South India or China whence the labour comes, though an occasional Tamil shrine or Chinese temple stands among the trees. The atmosphere of makeshift and impermanence is in contrast to the actual outlook of a rubber plantation which is above all long-term. Other crops, like rice, leave the ground cleared and ready, at the end of each year's harvest, for replacement by new sowings; the rubber tree and its work goes on regularly and the costs of making a change would be almost as great as the original cost of clearing the primary forest—for which reason the Japanese Occupation and the war leading up to it, failed to cause the destruction or change of more than a few per cent of the rubber acreage. Just as the dairy farm centring on the cow has produced a distinct cultural landscape and tradition elsewhere, so rubber is ripe for creating around it traditions and associations more intimately and permanently linked to the setting than is the case now in Malaya. That type of smallholding exclusively concerned with rubber differs from the large estate only in proportion, not in style, but the small-holding of two or three unevenly planted acres adjoining paddy or vegetables and cultivated on a family basis is more closely integrated to the environment, giving rise to family or co-operative tapping groups sometimes selling the latex to a larger factory. In total this last type of holding covers large areas though individual units are very small.

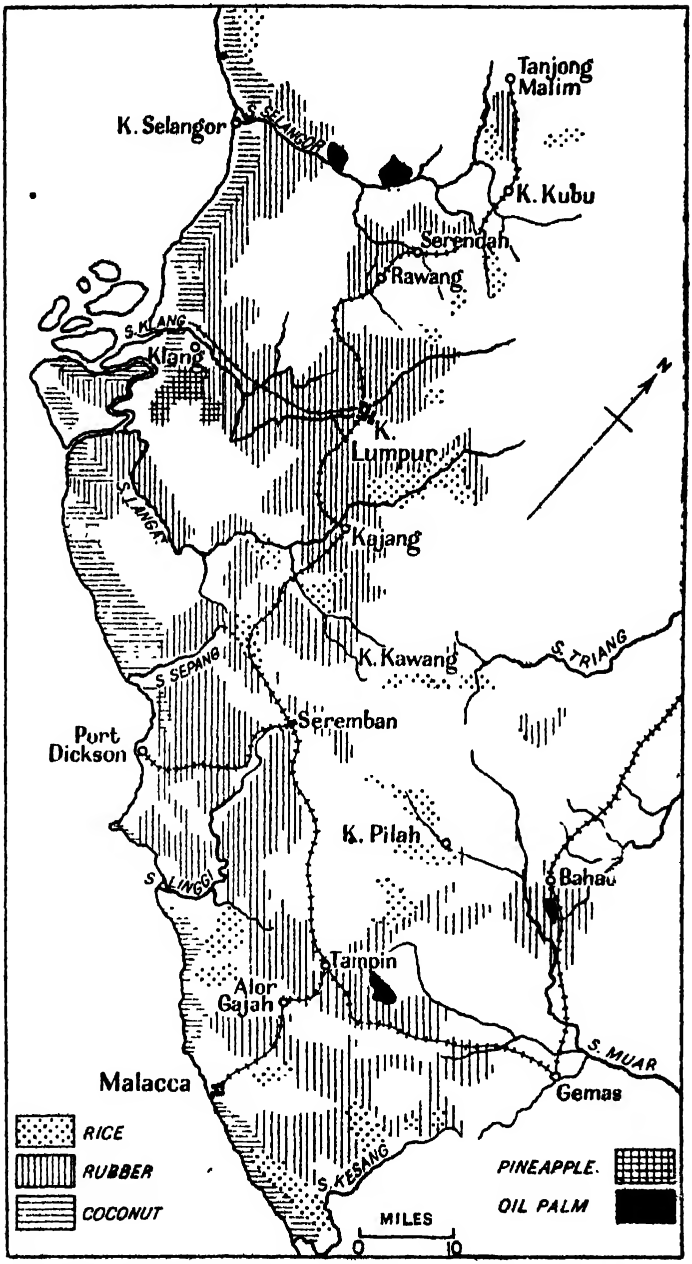

FIG. 38.—Land Use in Selangor, Negri Sembilan and Malacca

The aspect of planted rubber is one of a uniform crop from trees which, when fully matured, represent only a variant of the otherwise ubiquitous landscape of forest. Rubber trees to the south are not markedly seasonal in their leafing, though to the north where the dry season becomes more emphatic, rubber foliage turns red and then drops for some four weeks, about February; elsewhere the fall takes place sporadically and the estates as a whole appear evergreen. Controlled undergrowth has become widespread now that rubber can be called fully mature. The regular alignment of trees allows visibility within a plantation for as much as a quarter mile. Properly cultivated, rubber roots are not far below the surface, yet if soil erosion takes place roots appear to lie upon the surface itself. Silt pits along contours are customary erosion precautions, made necessary by the rolling or lightly hilly country which best suits rubber, whose vitality lowers if the roots are in soggy ground. Some rubber trees acquire a gnarled appearance as a result of careless cutting of the bark during tapping. Where rubber has been planted in badly drained lowlands, drainage ditches have been dug to lower the water-table. Roads through plantations, essential because of the coagulant acid, finished rubber and food supplies going to and from the plantation, are invariably of red pounded lateritic ironstone which makes a fair surface from easily accessible local materials. Isolation obliges most plantations to provide their own power either from diesel engines or from wood-burning steam engines.

Because external contact is necessary both for the sale of rubber and for bringing in the food of the labour force, rubber plantations need main road or railway communications. Hence the distribution of rubber relates to the pattern of highways and railways, as well as to the better drained lowlands or foothills. Association with immigrants who come in for other activities accounts in part for the concentration of rubber in the western belt of Malaya where at the same time the lowland forest zone is better accessible to port facilities, the last and essential stage in the export of rubber, which has practically no use locally.

Coconut and Oil Palm Plantations.—Besides being grown in small units for direct local consumption, coconut has developed as a plantation crop on large estates close to the coast where the necessary deep drainage is maintained by ditching with sluices to keep out the tide. Beneath the palms only short Victoria grass

grows without other undergrowth, so that the plantations seem light and open, although the ground is not worked. The labour used is much less than that in rubber growing and it is regular throughout the year because the tree fruits continuously. About 37,000 people were employed on coconut production at the 1947 census, which was less than the number of market gardeners. Many

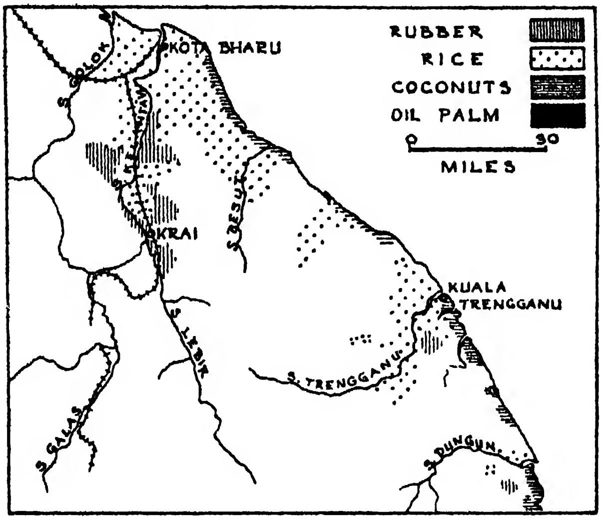

FIG. 39.—Northeast Malaya : Land Use

of those employed are Malays who usually build villages and houses within the plantation on traditional Malay lines so that the whole integrates well with the Malayan landscape. To convert the coconut meat into copra, either sun drying, smoke drying, or kiln drying is used, depending on the size of the plantation, but for this also the labour required is small in volume and unskilled in character. Smoke kilns predominate and they are fuelled by burnt husks; early drying is essential and must take place on the estate, which always ships its crop in the form of copra. Coconut oil is expressed from copra generally at portside, particularly at Singapore and Penang, or even overseas.

Coconut production for trade is an unstable activity. The price and demand fluctuates considerably and freight charges can easily squeeze away the profit from this low-grade, bulky commodity. Moreover it is highly competitive because part-time growers,

already assured of their food supply by other work, can sell their copra individually in small units which make a large total, at rates below those of wage-paying plantations. Altogether about two-thirds of a million acres of coconut stand in Malaya, mostly in units too small to appear on the land utilisation map except on the Perak coast (Fig. 36). Malayan trade figures for copra and coconut are difficult to assess owing to the high local consumption and the entrepôt trade in those commodities at Singapore. For 1950 Malayan production was 90,000 tons of coconut oil.

The Oil Palm (*Elaeis guineensis*), imported from West Africa, and not indigenous, is grown only in large plantations on riverine and coastal flats. These palms branch fairly close to the ground and the dead fronds persist for a long time, so that the plant has a more solid, compact appearance than the coconut, and although to each acre there are only about the same number of palms as in a coconut plantation, the estates appear denser and more continuous. Though there is negligible undergrowth, it is not possible to see far. As in the case of coconuts, practically no cultivation of the ground is done. The palm fruits continuously giving a regular daily labour rhythm. These plantations are large units, exclusively foreign, mainly British, generally employing South Indian labour in the same proportion per acre as the coconut plantation and there is no competitive smallholder production. A good transport system on the estate is essential and may be either road, light railway or canoe on the drainage canals; the nuts, which are fairly small and very numerous, must be treated immediately at a large, expensively equipped factory on the estate; the process is mostly expressive but several minor processes have to be used to prevent chemical changes. The oil moves from the estates as liquid, some going to Singapore by sea; special storage tanks are necessary for handling the commodity which has the same broad industrial uses as coconut oil.

Oil palm estates are distributed through Johore (half of all in Malaya), Perak and Selangor in that order of acreage (Figs. 36, 38, 43). They made a spectacular post-war recovery to export 57,000 tons of palm oil in 1950 (cf. 51,100 tons in 1938).

Other Cash Crops.—Pineapples, which fruit in December and June, eighteen months after planting, were at one time extensively planted by canning-factory owners in Singapore and Johore, where they were sometimes used as a catch crop in young

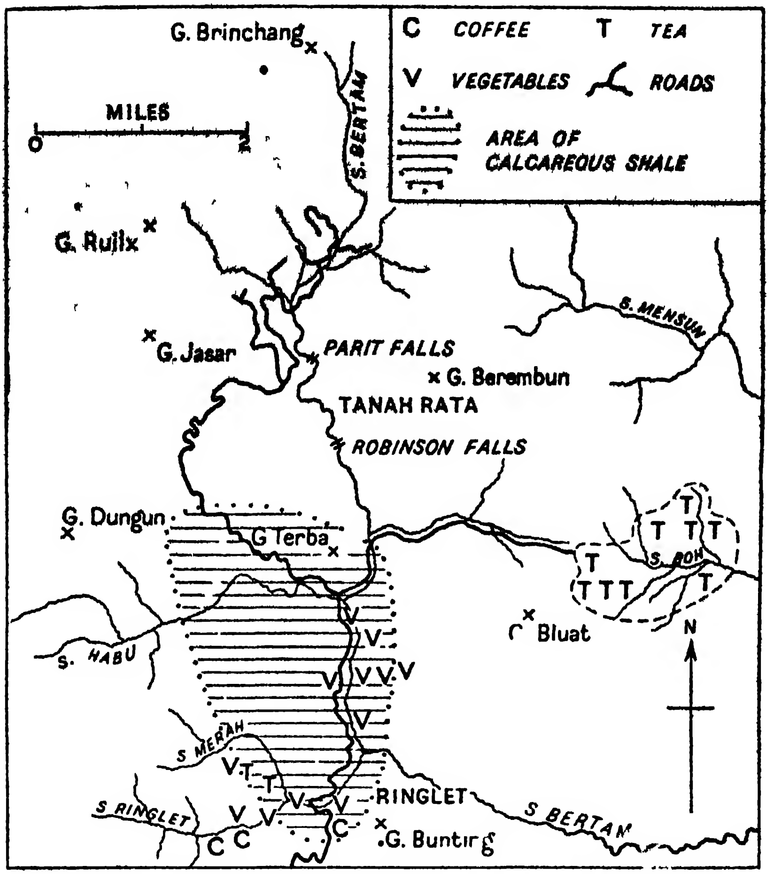

FIG. 40.—Correlation of Rocks and Land Use in the Cameron Highlands

rubber. It was essentially an industrialised activity, closely integrated with Chinese canners and exclusively using Chinese labour in a fluctuating and seasonal activity, which made very little impact on the landscape as a whole. The output went very largely to the British market.

Following its virtual disappearance during wartime, pineapple-growing abandoned the older hillside locations favoured by the *Singapore* variety and was re-established in a new terrain, the peaty soils of SW. Johore, where about 6,000 acres of a new strain, the *Mauritius*, were growing in 1948, mostly as smallholdings involving some 5,000 Chinese families.

Market gardening occupies fairly extensive areas round every

town though it ranks very low in total area. Almost entirely Chinese in character, it is the most intensive form of cultivation in Malaya, worked mainly on a family basis and essentially a cash occupation needing at least two persons per acre. In the Cameron Highlands, many smallholders produce temperate climate vegetables for consumption in the towns of the lowlands which are served daily by road transport (Fig. 39).

A number of minor crops for sale show in the list of normal Malayan production, though many continue only as catch crops. Of them, tapioca ranks exceptionally large in acreage, partly because it is a rice substitute and partly because it has a sale value for commercial starch. Sugar, maize, gambier, tea, coffee, spices, tobacco, derris and groundnuts are also grown on a small scale for cash sales. Almost all these minor crops are Chinese or Indian activities and their total significance on the Malayan landscape is negligible; they inject little into the Malayan stream of internal trade and even less into the external stream.

(*b*) *Mining*

Tin.—With the exception of lode tin mines in Sungei Lembing (inland from Kuantan) and gold mines at Raub, Malayan mining is characteristically operated as various types of open-cast and is mostly alluvial, especially in tin mining. Thus mining makes an impression on the landscape which is out of proportion to the tonnage produced (57,500 tons of tin from 703 mines in 1950).

The tin ore (cassiterite, containing about 75 per cent tin) occurs mostly in weathered grains scattered through gravels and sands; it may be elluvial (weathered *in situ*) but the majority is alluvial, that is, originally water-borne and partly sorted by flowing water. The principle of mining remains the same—removing a "dead" surface, breaking up the tin-bearing alluvials and washing away the sands, clays and gravels by a water method which leaves behind the heavy cassiterite grains. Techniques vary, however, and make different impressions on the landscape.

1. *Dredging:* This method has been the most productive and labour-saving since 1929. The dredge floats in a pond (technically called a paddock) covering about 4 acres and its steam or electrically-driven buckets on an endless chain draw up from underwater the alluvium. As this is removed the dredge

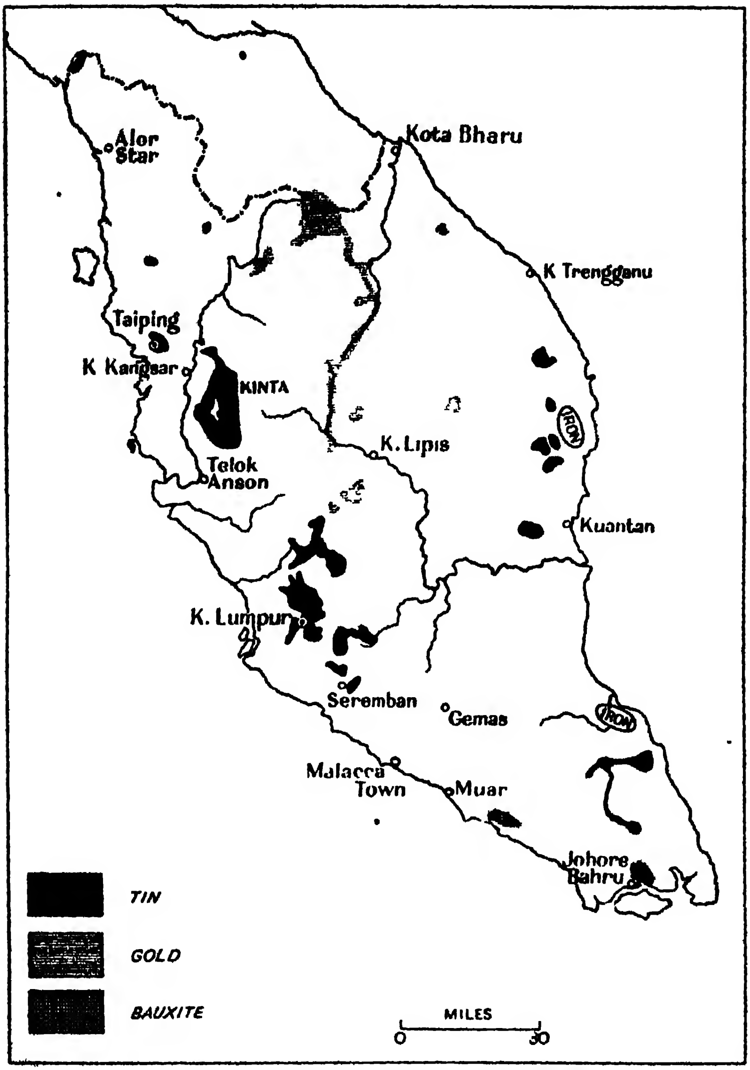

FIG. 41.—Locations of Malayan Minerals

moves on, progressively excavating the bottom and sides of the pond. Within the dredge, the alluvium is screened to remove the tin and any other minor minerals, and the rest passes out as tailings which are spread by sluices behind the dredge. Thus the dredge ultimately transfers its pond slowly from place to

place. The tailings lie only a little above the surface of the water to form loose swamps for hundreds of yards behind the dredge, and, being soilless, these tailings can only be slowly colonised by vegetation.

To build a dredge is expensive (£25,000 to £50,000 each), so that this technique is confined to large-scale, heavily capitalised mines, chiefly European. By dredges a high extraction rate can be assured and alluvials once dredged are not worth going over again. Because only a few labourers, of the skilled artisan type, are employed, such mines have few buildings round them and these are often temporary, so that labour can move closer to the dredge as it moves on. Dredge mines are located in or close to river beds, but they do not make great demands on water supply—the same water is being used over and over again and fill-in by the tailings goes on automatically. Cheap tin may always be expected from dredges, which need very little labour. Most dredges were destroyed during the war and they were not quickly replaceable owing to the demands for heavy equipment in other parts of the world; 78 were operating in 1950, employing about 16,000 people.

2. *Gravel pump mines:* These tin mines open great pits in the alluvials to form scars on the landscape for long periods at a time. They can conserve the topsoil separately from the rest and spread it again over the alluvials once the mine is filled in, so that they need not permanently affect the landscape, though in point of fact careless infilling has mutilated large areas of landscape by preventing regrowth.

The pumping, by steam, diesel or electric power, is part of the process of raising a mixture of water and tin-bearing gravels by wide pipeline to the top of a high-level sloping sluice, built on tall timber trestles which stand everywhere on a Malayan mining landscape. The sluice upon these trestles is stepped and the tin ore gathers in the steps while the gravels are washed away by the continuously pumped water. Gathered from the sluice, the cassiterite is rewashed before drying and sacking for shipment. The tin-bearing alluvials are mixed with water by jets (monitors) playing on the sides of the pit, and the water carries the alluvials in a muddy stream to a "gravel pump" at the bottom of the pit. Tailings on these mines are derived from chutes here and there along the sluice and from

its lower end; they are spread out loosely round the mine to form a landscape of dead land covering greater areas than those left by dredges. Considerably more labour, chiefly unskilled, is needed, and round gravel pump mines lie haphazard groups of thatched, wooden, earth-floored miners' huts. Nearby there must be a pond or impounded stream to provide water for the monitors and when mines are abandoned the pits often fill with water and remain as deep lakes.

The proportion of extraction by this method varies and often the tailings merit being worked over several times by successively better methods. Some Malayan areas have already been worked over four times. Work often goes on continuously day and night. This type of mine can be rehabilitated fairly quickly, it needs less machinery than a dredge and is not confined to heavily capitalised undertakings. Ownership is very mixed; European, Chinese and Indian firms own gravel pump mines, and by 1950 about 500 Chinese gravel pump mines were operating with 22,000 labourers.

3. *Other forms of Tin Mining:* Hydraulic mining resembles the gravel pump mine in most respects as far as technique, layout and form are concerned. It differs chiefly in using a pipeline from the hills to supply the head of water for the monitors and to motivate the gravel pumps.

Several true open-cast mines are operated, the Hong Fatt at Sungei Besi, being the outstanding example; in these, the alluvials are mechanically excavated from spiral terraces round the sides on which run rails for trucks and mechanical grabs. After being hauled to the surface the alluvials are treated with water as in gravel pumping.

The primitive method of panning by hand, to separate the cassiterite grains from the other gravels, better known in connection with gold prospecting and mining, has also been extensively used by small free-lance miners employing Chinese women coolies. In Malaya, panning is known as *dulang* mining, a form much used by miners during slumps when larger concerns closed down.

At the Sungei Lembing lode mines, not far from Kelantan, the usual system of vertical shafts (to 1,200 ft. depths) is used, and the ore comes to the surface for crushing and roasting, an unusual technique in Malaya. This particular installation of the Pahang

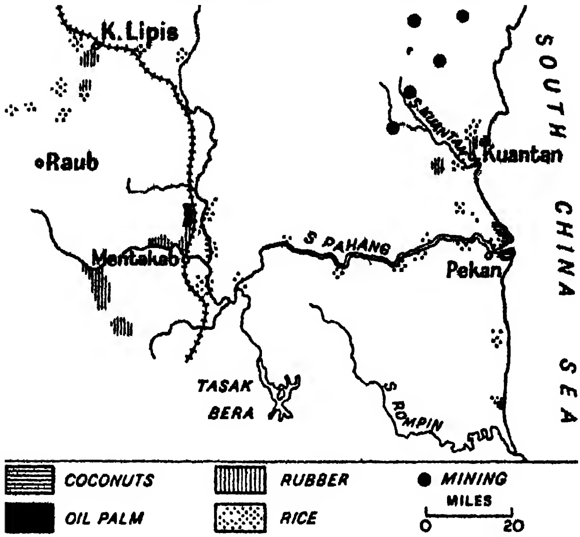

FIG. 42.—Pahang: Land Use. Areas left blank are forested

Consolidated Mining Company is large, heavily capitalised and elaborately equipped.

Most of the labour on tin mines has always been Chinese, supported in immediately pre-war years by Indians in the proportion roughly nine to one. Only a few Malays worked in this industry. The number of people employed varied with the prosperity of the industry which has changed considerably; in the six years 1933-38, annual production varied from about 25,000 tons to over three times that figure, and labour was recruited or discharged accordingly. There were about 46,000 workers on the mines in 1950 when Malayan tin production was 57,000 tons, as compared with 83,000 in 1940 when the production was 85,000 tons. Even for labourers, the industry was thus a gamble; some workers were employed on daily wages, though housing and food were provided; others worked on contract and were paid according to the volume of ground cut away. A few groups of miners worked as a form of co-operative, sharing profits after the tribute (royalty) of the actual lessor had been paid.

From the human geography standpoint, the cultural landscape of mining was transient in most respects, except that the industry in boom years attracted mining rushes and it left relatively per-

manent scars of tailings and ponds on the worked-over landscape. This last was not in general serious from the agriculturists' point of view, since only occasionally had suitable alluvials been found under land already intensively cultivated. As a remoter effect, by altering the rate and incidence of natural sedimentation, tin mining has changed water-courses, increased deposition and clogged estuaries, particularly on the west coast, in Lower Perak and Selangor.

The pattern of Malayan tin mining is thus set by alluvial deposits which have brought cassiterite from its veins at contact zones and fissures in the rocks adjoining the igneous intrusions. These deposits lie predominantly among the foothills to the ranges, where break of slope has lowered the capacity of streams to continue carrying heavy cassiterite. Thus, the mining zones flank the Central Range throughout its length, more especially on its west side, in the Kinta Valley and round Kuala Lumpur, where about three-quarters of Malayan tin is produced, but there are workings at Bentong and a few other points east of the Range to the south (Fig. 41). Other workings flank the Nakawn Range in Perlis, the Western Range and the Bintang Range (chiefly round Taiping). On the extreme East, workings are few, largely due to inaccessibility, and are scattered on the coastal side of the Eastern Range all the way from Besut River to Johore; of these, the Sungei Lembing lode mines are the most important.

It has been estimated that Malayan tin mines have an average expectation of about 24 years of life from 1946 (see also Fermor). Although tin has played a major part in Malayan external trade, it has only a subdued rôle on the landscape and in human activities within the country, which are more extensively affected by the rubber and paddy industries. So far the great asset of Malayan mining has been its low average cost of production which remained far below that of any other major tin-producing zone of the world.

Cassiterite leaves all mines in granular form to be transported in sacks by rail to Penang and Singapore where two furnaces up to 1942 handled about half the world's tin, importing ore from surrounding countries in addition to handling Malayan ore. Thus tin smelting was a more stable industry than mining itself. To smelt tin the ore is mixed with limestone and anthracite, the former gathering the non-tin minerals and the latter reducing the tin which is further refined to over 99 per cent pure in cast-iron

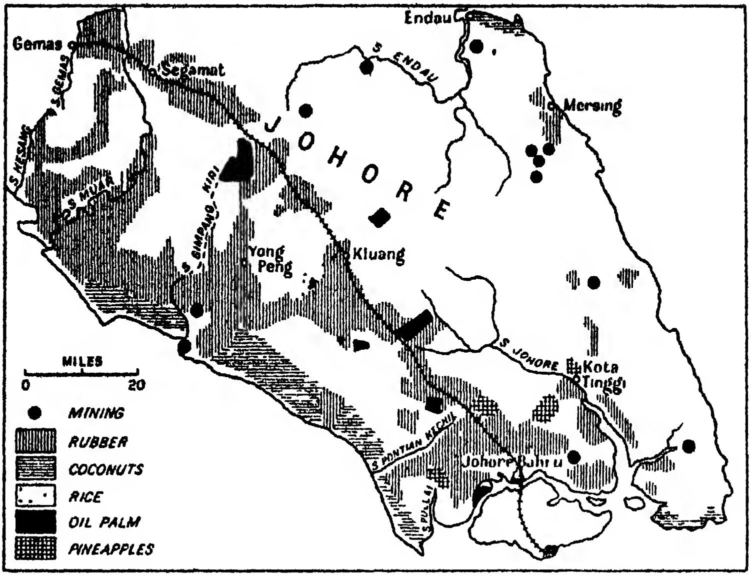

FIG. 43.—Land Use in South Malaya

kettles before flowing into moulds. These smelting works were not materially damaged by the war and have in fact acquired greater significance due to the destruction of rival smelters at Arnheim, offset in part by the growing tendency of United States consumers to import tin ore and do their own smelting.

Iron.—By 1940 Malaya was annually producing nearly 2 million tons of iron ore derived from haematite deposits in Johore, Kelantan, Pahang and Trengganu, which have an iron content of 50–65 per cent, thereby ranking as high quality ores (Fig. 41). The Johore deposits (at Batu Pahat and Endau) (Fig. 43) and the Trengganu deposits (at Dungun and Kemaman) (Fig. 39) produced over 80 per cent of the whole. The mines were worked on the open-cast system, using Chinese labour, and causing considerable local landscape changes in what had been virgin territories. The great bulk of the production made a substantial labour demand, out of proportion to the low value of iron ore production compared with tin. Since the majority of mines were on East Coast sites, they had to devise their own transport system which was chiefly by river barges down to the coast. They faced difficulties of harbourage (no major steamers can come inshore for loading

on the East Coast and they must anchor offshore to load from barges), difficulties of transhipment during the heavy Northeast Monsoon seas, and remoteness from suitable coal deposits. Before the war, iron mining was exclusively a Japanese-financed industry and the whole production was shipped to Japan for smelting. During the occupation, a little smelting was done in charcoal furnaces, a most wasteful method, not likely to be continued. The problem of exploiting this iron must arise again, though the previous difficulties of access and coal supply are unchanged. The problem is specially acute for Trengganu, where the deposits are of good grades and easily worked and form the only major cash-producing asset of the state. The mines restarted in 1949.

Gold.—Small quantities of alluvial gold occur at many places in Kelantan and northwest Pahang, and in association with tin alluvials of the Bidor-Tapah area of Perak, of Malacca, and parts of Selangor. These alluvials are sporadically washed for gold by small groups of prospectors. No major undertaking is concerned with gold except at Raub, where lode mines with shafts as much as 1,000 ft. deep can produce about 28,000 ozs. troy annually (14,000 ozs. in 1950), the whole process of crushing and amalgamation being done at Bukit Koman, near Raub.

Other minerals.—Low-grade manganese ores have been mined in conjunction with the iron ores of Northeast Malaya and sent to Japan. In Kedah and Trengganu, small tungsten ore (wolfram) deposits were regularly worked for sale to the United Kingdom and the United States. Superficial and shallow deposits of bauxite were quarried immediately pre-war by Japanese firms at Batu Pahat and just east of Johore Bahru; no facilities for extracting the aluminium existed locally and the total export of ore did not exceed 60,000 tons per annum. Aluminium works in Australia have called for tenders to supply them with Malayan bauxite. As a by-product of tin mining, ilmenite (titanium ore), together with monazite (a source of thorium) are recovered magnetically from the refuse, but the production varies widely (19,000 tons ilmenite in 1949, cf. 2,600 tons in 1940), and comes largely from the Perak and Selangor mines.

Chapter Eight

THE SOCIAL GEOGRAPHY OF MALAYA

BECAUSE the development of Malaya into the forms of today has taken place within the last 150 years, it exemplifies geographical factors involved in changing the ecology and associations of life in tropical areas.

THE EVOLUTION OF MALAYAN LIFE

Before the end of the 18th century, the pattern of Malaya was simple and Malays lived as self-supporting rice farmers and fishermen with only a little interchange between these groups in a few districts of specialised activity. Probably a population of no more than a quarter million was involved, and people lived in settlements strung along the coasts and rivers where transport by small boat, drinking water and irrigation water, were available. The dense forest seems to have repelled the Malay no less than it repelled the foreigners who occasionally passed by on the high seas, and it was left as a negative no-man's land between the settlement lines of rivers and coasts. Thus Malay political units, sultanates, chieftaincies and so on, were shaped round estuaries where rice growing was easy and where the coastal and riberine strings of villages met. The interfluve was a forested frontier zone to political units undefined by boundaries and among its forests wandered a few poorly-organised debilitated aborigines.

Malay society was communally self-sufficient, a nice balance between the amount of food needed and growable and the number of hands available to produce it. All the Malayan agricultural products grown for sale today and at various times tried commercially, are foreign innovations. Apart from spices, nothing cultivated by the local people then had exportable value; even rice, which had become their staple food, was introduced by first millennium Indian colonists to this setting which is more naturally fitted for yam cultivation. The trade in spices which developed round medieval Malacca was of small volume, and depended on a few trees in native gardens rather than on large-scale plantations

Equally repelled by the Malayan surface, the first modern settlements concentrated on the coast, where position relative to the whole region attracted Arabs, Indians, Chinese and Europeans in succession. The Portuguese and Dutch trading post was Malacca; the first British posts were on the Islands of Penang and Singapore, isolated from the peninsula, and following until 1874 a general directive of avoiding political ties or mainland responsibility.

When interest turned to the Malayan mainland, its physical difficulties and their variations from place to place had to be taken into account. There are four main types of surface : unpopulated forest-covered ranges of which the Central Range is the most prominent; foothills flanking these ranges, forest-covered but well-drained and partly broken up by lines of pioneer Malay settlements; a badly-drained zone of freshwater swamp forest, forbidding to settlement and to cultivation and penetrable only along the rivers; and a healthier coastal strip of mixed farming and fishing, with here and there an intensively cultivated plain or a rocky outlier which sedimentation had converted from an island to part of the mainland. This fourfold pattern is arranged roughly symmetrically to the Ranges but the Central Range is nearest the west coast at certain points, serving to narrow that repellant unit, the marsh zone.

In the foothills lay Malaya's great attraction to external interests, alluvial tin, and accessibility to the foothills was the most important consideration to the western tin belt, which is richest and nearest to the coast. To these foothills, only the rivers provided access and along them the first outsiders were able to move through the marshes, concerned with rivers not only as a means to travel inland, but also as a means for sending out the heavy, bulky tin and for bringing in the food for miners who were working in areas generally far from local agriculture. Local agriculture was in any case closely involved in a tight subsistence ecology without appreciable surplus for sale.

At two places, on the Larut coast and at the mouth of the Klang River, ranges came so close to the coast that the tin belt in their foothills could be easily and quickly reached by poling shallow-draught canoes and boats along streams too shallow for large ships and never very significant even for Malay settlement. Hence the first two mining settlements inside Malaya were round what are

now Taiping and Kuala Lumpur where the first mining was exclusively Chinese in management, labour and financing. Kuala Lumpur as described by Sir Frank Swettenham in 1874 was merely a dozen squalid thatched huts. Later it became the focus of a Chinese tin rush with all its attendant disorder and riotousness and today it is a wealthy modern city and capital of the mainland, though containing only 176,200 people (1947).

This opening up of mines did not produce an economic struggle between miners and farmers, nor a struggle between Malays and Chinese, because in those first zones Malay settlement and Malay farms were negligible, so that there was no significant displacement of the old by the new or of the indigenous by the foreign. The state of Selangor, where Kuala Lumpur is, had an extremely small Malay population in the third quarter of last century when mining was beginning to assume importance and the sultanate capital of the time, Bandar Termasa, was a poor, neglected, unhealthy village on a swampy flat at the junction of the rivers Langat and Jugra, resembling the primitive settlements to be seen today on the lonelier parts of the Borneo coast. The Chinese miners worked on concessions from the sultans at a royalty of 10 per cent on production. The disorders of the mining areas arose from disputes among rival groups of Chinese prospectors, not infrequently due to Malay chiefs granting new concessions which, being ill-defined and unsurveyed, overlapped, infringed or ignored previous concessions. Malays declined to do mining labour themselves and all work was done by Chinese, often imported under dubious conditions direct from China by the concessionaires. Friction between rival groups was aggravated by the traditional banditry and clan fighting which the Chinese brought with them. They came from separate clans of South China and were often as unintelligible and foreign to one another in speech and customs as they were to the Malays. What the number of immigrant miners was at that early time, prior to British intervention on the Malayan mainland, is not clear. In 1891, by when a fairly reliable enumeration became possible, nearly 90,000 Chinese arrived to work in the peninsula, though there were probably well above 100,000 already in the mining districts.

Miners do not farm, in whatever part of the world they prospect, and these Chinese immigrant miners depended on imported food. To cater for them, other Chinese set up shops and brought in commodities from outside. Even Malay villages then had no shops.

The advent of miners, and later, planters, working a money-based economy, introduced money into rural Malaya, accompanied by the development of rural shops and trading centres. Into this new Malayan setting of middlemen and shopkeepers, the Chinese quickly fitted, helped by earlier experience elsewhere in the East where certain types of them had already a long tradition as traders and middlemen. As a result, throughout Malaya today shops and mercantile businesses are almost exclusively Chinese interests, although there are a few rival Indian traders who came in with an eye on the parallel needs of Tamil labourers brought into the rubber estates this century.

The tin rush had little effect on Malayan agriculture, though it might have been expected that the presence in the country of so many extra rice-eating consumers would stimulate Malayan cultivators. The Malay remained tied to his original ecology, justified to some extent by the limited areas of land in Malaya with just those conditions of fertility, level and drainage which suited paddy. The steady natural increase of Malays which has in fact gone on since 1874 (the Malay population today is probably some six times what it was then and rose 35 per cent over the period 1931-47) means that their resources were already sufficiently strained by needing to expand their food growing areas to keep pace with their own natural increase.

At Kuala Lumpur and Taiping, the inward movement of people, food and essentials, and the outward movement of tin ore, led to the building of short railways to the nearest coastal points (Port Swettenham and Port Weld), replacing poling along the rivers which was unsatisfactory, unsafe and very soon inadequate as the rivers rapidly silted up when mining got fully going. Later a railway was built longitudinally to link these early mining centres, through the western foothill belt and in turn this longitudinal railway made it possible for mining rapidly to extend along it. Thus railways, paid for by tin, preceded roads in Malaya.

Despite increasing British interest in the mainland from 1874 onwards, Malayan tin mining continued to be very much a Chinese activity. European finance, management and techniques were introduced when mining became a matter of heavy equipment, competitive costs and high capitalisation. Now that much heavy mining machinery has been destroyed by the 1942-45 war, there has been an emphasis on Chinese mining forms.

Gradually the Taiping-Kuala Lumpur railway line was extended during the nineties to link Malacca and Prai (for the ferry to Penang) and ran completely to Singapore by 1909. The line initially and in extension kept well inland to the foothills and away from the marshy forests behind the west coast. It was characteristically a national railway, capitalised and run without resort to publicly raised external capital. Inspired by and located for the tin areas, the railway both encouraged speedier development of that activity and fixed the pattern for future opening up of the mainland. It assured export of commodities from the interior and import of food for immigrants. When the time came for new agricultural plantations and associated industries, they gravitated towards the railway, which moulded them into a longitudinal pattern round the railway as axis. Bridle paths through the forest were the early feeders to the first railway. The present road system developed later than the railways, to feed them; roads came later than the railways because in the forest where indigenous draught animals were negligible and horses unsuitable, roads could have little value until motor transport evolved. When they became practicable roads followed patterns roughly complementary to the railways.

Roads were first designed in Malaya to serve the railway rather than to compete with it or duplicate it. Only when oil-driven vehicles came into general use were longitudinal roads constructed through the west coast zone. Even by 1942, no through road paralleled the east coast but an eastern railway through the mountains and valleys from Gemas to Kota Bahru followed principles worked out on the other side of the Central Range. It was linked to the east coast by a long road to Kuantan and by the old river route down the Pahang, whose middle course was not far from the railway (Fig. 36). This line had only a limited service before 1942 when the Japanese removed its rails for use in Siam, and it was not restored until 1948.

Two zones of comparatively dense road network now spread out, bounded in each case by the Malayan ranges:

(*a*) From Butterworth south to the Kinta Valley;

(*b*) From Kuala Selangor to Muar.

These are both zones of old-established and elaborate development in mining and planting. Elsewhere, except on Singapore Island, the road network is very open and has frequent dead-ends.

The absence of coastwise roads reflects the difficulty of crossing the wide, swampy estuaries which mostly still have to be ferried. Where N-S. roads do exist, they are generally confined to foothill zones and do not in any case link with road systems through the Kra Isthmus where the railway has a monopoly beyond Singgora. Only two highways cross the Central Range, linking the mining and planting settlements on either side and encouraging the development of hill stations, one of which, Cameron Highlands, has become a producer of vegetables (Fig. 40), using a daily road service to the lowlands.

In 1890, after the major tin rush, there began the move towards cultivating rubber and the locations sought by British planters for this purpose were close to those originally sought by the Chinese tin miners. There were two reasons. The foothills where the tin occurred had the advantage of good natural drainage and therefore suited rubber trees, which had to be out of the swampy lowlands. Moreover, the railway built for the tin mines provided the communications which were needed for rubber plantations, whose supplies, particularly rice for their Indian labourers, had to be brought in from outside, and whose rubber needed to be sent abroad. The rubber plantations gravitated to the western foothills as ribbon developments along the railway lines and although plantations gradually fanned out from the railway, even today the land utilisation map shows how closely the distribution of rubber correlates with the railway and the road system.

The Malay tradition of self-sufficiency presented a wall of opposition to the introduction of exportable crops, whether of the outstandingly successful rubber or of the less successful sugar, coffee, gambier, coconuts and oil palms, which Europeans introduced, with the result that, failing to get the innovations taken up by local farmers, Europeans took to farming themselves in contrast to the turn of events in Burma and resembling those of the Indies. Even this was no easy solution because the plantations had to be in virgin country to get suitable soils, and at the same time needed labour which local communities were ill-adapted to supply because every hand was needed for food production. In Malaya, planters remedied the situation by bringing in agricultural labourers from abroad. Thus the South American Hevea was grown in Malaya by European methods with predominantly Indian labour, and the Malay was not involved until the First World War, when he tried a little

rubber planting, more in the spirit of gambling than of farming. So far as most Malays were concerned the innovation caused little disturbance in their way of life, since it occurred on land which had been forest and not on lands involved in their rice ecology. They steadily drifted into wage-earning occupations, so that Malays formed 12 per cent of the estate labourers by 1947, or 18 per cent if with them be included Indonesians.

All these influences have worked to establish the greatest concentrations of people and the exploitative industries (rubber and tin) in the belt of West-Central Malaya, running from Malacca, through Kuala Lumpur to Ipoh and Taiping (Fig. 44). To this belt of immigrant peoples and foreign innovations, Kuala Lumpur is as focal as midpoints of a belt can be, thereby justifying its selection as the capital of the newly-established Federation of Malaya (1948). It has assumed this rank because (*a*) it is the old-established focus of a wealthy, commercially active tin and rubber zone, (*b*) it is exclusively Malayan in interest, by contrast with coastal towns, (*c*) its choice as a federal capital was aided by not being a sultanate seat and thereby not the traditional focus of any one state. Kuala Lumpur is not particularly central to the peninsula yet no other point rivals it for centrality in view of the configuration which disperses rather than focuses natural routes. The centrality of Kuala Lumpur to the "Tin and Rubber Belt" has been deliberately emphasised by transport systems which link it to all the well populated zones.

The other dense population centre, Singapore Island, has been less a centre for Malaya and more an entrepôt for Southeast Asia; it is foreign to Malaya both in population (729,000 Chinese out of 941,000 in 1947) and in economic interests, which are trade rather than production.

In the far northwest and northeast corners of Malaya, the Malay continues his life much as before, fishing, farming for his rice and nearly self-sufficient; very little change has come to him through the great and speedy immigrations of Chinese and Indians in West-Central Malaya, and though the Second World War has stirred his nationalism, it has not given him means or numbers to balance, rival or subdue the newcomers in a combination of the Federation of Malaya and Singapore, though in the Federation the Malays in conjunction with Malaysian or Indonesian immigrants roughly equal in numbers the combined Chinese and Indian population.

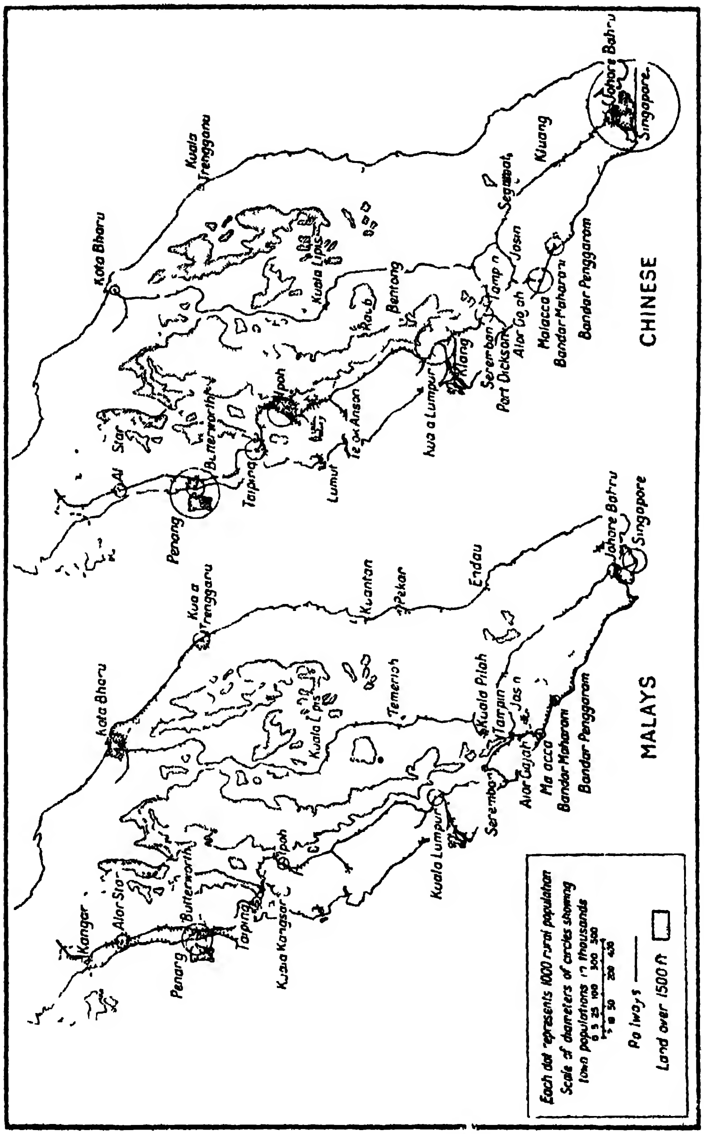

FIG. 44.—Distribution of Population in Malaya (Based on 1945 estimates)

Broadly speaking, Malayans do not form a plural society in the sense of several groups struggling to occupy the same land or the same occupations; it is a cellular society of different cultural, linguistic, ethnic and economic communities living their separate ways in different parts of the Peninsula and stratified socially within themselves.

COMPOSITION OF MALAYAN POPULATION
(in thousands, 1947 Census)

	Malays	*Other Malaysians*	*Chinese*	*Indians*	*Europeans and Eurasians*	*Total*
Federation of Malaya	2,130	265	1,880	534	19	4,867
Percentage ..	44	5	39	11	—	100
Singapore Island ..	72	43	728	71	18	938
Percentage ..	8	5	78	4	2	100
Total	2,202	308	2,608	605	37	5,805
Percentage ..	38	5	45	10	1	100

Distribution of Ethnic Groups

Thus the ethnic groups of Malaya have taken on a distinctive pattern, which, although modified to some extent by the war which emphasised population in the west and the south and accentuated urbanisation, continues to have much the same form. In detail the intensities may have altered a little, more so in the case of Indians than in the others. The following brief analysis assumes that only settlements of over 10,000 people may be called towns and derives from the 1947 census.

Malays.—Only three towns, Butterworth, Kota Bahru and Trengganu have Malay majorities, indicating that Malays are not normally urban, though groups of them live on the fringe of most towns. The greatest densities of Malays in rural areas are:

1. In the northeast, on the rice-growing plains of Kelantan and Trengganu.
2. Along the northwest coast from Taiping to the Siamese border, where rice farming and fishing draw Malays into relatively dense groups over fairly large continuous areas.
3. A narrower fringe of more dispersed and less homogeneous Malay settlements from Malacca southwards along the Johore coast to Singapore.

Nowhere else are there concentrations of Malays, although all the coasts and rivers have scattered Malay hamlets, too dispersed to appear on any but inch to the mile maps. Malays totalled at the last enumeration (1947) just over two millions, 44 per cent of the total mainland population.

Immigrant Peoples.—Malayan non-indigenous people, principally the Chinese and Indians, have settled densely in a belt about 40 miles wide down the west coast, where concentrate 90 per cent of the Chinese and 95 per cent of the Indians living on the mainland. In this belt are nine out of ten of the peninsula's large towns, a symptom of the urban preferences of immigrant peoples. The immigrant communities are far from evenly distributed; south of Muar and north of Butterworth their density thins markedly.

The Chinese, apart from a few shopkeepers and small dealers, have avoided the east coast (even though it faces their homeland) and also the sultanate of Kedah. East of the Central Range the only large Chinese settlements are Raub and Bentong. Along the west coast belt large urban concentrations of Chinese are in Johore Bahru, Muar, Malacca, Seremban, Kuala Lumpur, Ipoh and Taiping. In districts round Taiping (41,396) and Ipoh (90,635), which have in turn been the focus of Chinese activity in the northern part of the "Tin and Rubber Belt," dispersed groups of miners form the chief extensive settlements of Chinese in the peninsula. Between the Kinta Valley (Fig. 38) and Kuala Lumpur the Chinese population thins out, but from Kuala Lumpur southward, along the coast and the railway, there are fairly regular and extensive rural Chinese settlements.

By comparison with that of the Chinese, the map of Malayan Indians is very open; the group has experienced a post-war decline of 7 per cent. There is no sharp differentiation between the distribution of Indians and the distribution of Chinese, which roughly parallel one another. In the Kuala Lumpur-Klang-Malacca zone is the most even and dense distribution of Indians, that being the zone of old and extensive rubber plantations which have chiefly attracted Indian labourers. Another concentration of Indians is from the Kinta Valley to Butterworth, also a rubber zone. Outside these two areas, Indians are not prominent and east of a line from the Central Range south to Muar, Indians are comparatively scarce.

Regional Geography

In subdividing Malaya into regions, the following factors have to be considered:

1. Because dense forest covers highlands and lowlands alike, it makes them equally difficult to human activity, so that orographic delimitation is not a primary consideration.
2. Marsh and swamp forest have obstructed human activities more than any other landscape type.
3. Climatic distinctions are subdued and condition only the incidence, not the character of local rhythms.
4. The cultural landscape is more differentiated than the physical.
5. Indigenous groups used interfluves as boundary zones and rivers have had major significance as lines of entry and development at all stages.
6. Lines of transport not only establish coherence but also set the pattern of actual and potential development.
7. External considerations have been at least as strong as internal factors in Malayan development.

Population distribution and economic development justify a primary division into Western and Eastern Malaya, using the Central Range as main boundary, extended south along the watershed between rivers leading to the Malacca Strait and South China Sea and terminating at the Johore Strait between Johore Bahru and the Johore River. To Western Malaya the railway and road system forms the main artery; to Eastern Malaya the line of movement is mainly eastwards along the rivers to the coast and coastwise. Singapore Island is best treated as a region separate from these two primary peninsular regions, which subdivide thus (see end-paper):

Western Malaya

(*a*) Northern Coastal Plain, west of the Western Range from the Siamese border to just south of Province Wellesley, a zone where Malays predominate and subsistence farming on a rice basis is the development type in a climate with a slight dry season. The Langkawi Islands, best thought of as outlier of Malaya, resemble the Nakawn Range, and they are more interesting geologically than geographically, since they support only a few hundred people in small bays on a karstic limestone landscape.

(*b*) The Mountain and Valley zone of broken, isolated, little-developed country between the Western Range and the Central Range, terminating north of the Taiping-Kuala Kangsar railway.

(*c*) The Tin and Rubber Belt, in the foothill zone from Larut and the Kinta Valley southwards to include the coast south of Port Dickson and stretching to Singapore. A zone of intense tin and rubber activities, linked throughout by railway and a dense road network, it has developed on the basis of production for export and is populated by Chinese in large pioneer nuclei and by Indians dispersed in the rural areas. Only in Malacca and in Negri Sembilan are there small enclaves of the Malay subsistence-farming landscape.

(*d*) The West Central Marshy Coast, including the Perak, Bernam, Selangor and Langat River estuaries; an undeveloped, repellant zone typically fringed by mixed fishing and coconut-growing colonies on the coast itself where there are distinct rocky island zones (the Dindings) now silted up to link with the mainland. On this coast are outports, Telok Anson for Ipoh and the Kinta Valley, Port Swettenham for Kuala Lumpur.

(*e*) Penang; entrepôt for (*a*) and the Kinta Valley portions of (*c*).

Originally established as a centre for buying spices and selling textiles and opium to Northeast Malaya, Penang Island, a granite cored outlier of northwest Malayan ranges (area 110 square miles, maximum height, 2,722 ft.), was taken over uninhabited (1796) as a potential mercantile and naval base, a pawn in the competition between the rival British and Dutch East India trading companies. It provided one of the few available deep water anchorages for sailing ships coming before the wind across the Indian Ocean, but did not protect them from the violence of storms from east and west. As long distance shipping displaced trade routes across the Kra Isthmus into Siam, Penang lost its earlier significance as fulcrum of Malayan, Burmese and Siamese interests and became an entrepôt, yet its location finally proved inconveniently far from direct routes between East and West. Development of the Malay Peninsula gradually shifted well south so that, while the port continued to increase its population and trade, it did so less rapidly than Singapore, which outpaced it. From being deserted in 1790, the island of Penang carried 20,000 people, mostly Chinese, by

1801 and by 1947 had 446,422 people, of whom about half were Chinese and one-third Indian; the town itself has an even higher Chinese proportion. From these Chinese came those who made the first tin rush to Taiping so that Penang was from the beginning the "outport" of the northern mining interests, maintained to some extent today by the presence of a smelter. Rubber plantations centred much farther south, so that as the rubber trade came to the fore, Penang's trade decreased, to become half Singapore's by 1825, and one-third by 1864, shrinking steadily in proportion into this century, yet grossing $1,400 million in 1950.

The railway into Siam brought a considerable tin and rubber trade from Kra to Penang, yet even in this trade Penang suffered from the increasing hold of Singapore as the greatest entrepôt for the South China Sea. Although the town occupies only a small fraction of northeastern Penang, very little farming is done now in rural areas where sugar, tapioca and spices for export were cultivated at the end of last century. The town has functioned as a stepping stone for much of the Indian coolie labour which has gone into Malay's pioneer industries from Madras.

Eastern Malaya

(*a*) The Kelantan-Besut delta zone north and east of Kuala Krai is a densely populated rural zone concerned almost exclusively with Malay self-contained farming for paddy with subsidiary fishing.

(*b*) The East Coast Fringe, isolated from the mainland by a difficult terrain of broad marshes, occupied by discontinuous Malay fishing communities with subsidiary subsistence farming and linked by coastwise shipping in small boats.

(*c*) The mountains and valleys of West Pahang, running from the Middle Kelantan Valley along the east of the Central Range as far as inner Negri Sembilan. A complicated terrain of mountains with two sets of emphatic valleys on N-S. and E-W. lines, sporadically developed for mining by Chinese in the Raub-Bentong district, with a few Malay subsistence paddy farming valleys towards the south (Kuala Pilah). The developed areas are linked by roads across the Central Range to Western Malaya. The N-S. link of the railway from Gemas to Kuala Lipis has been restored and lies well east of the mining areas, though it has attracted rubber plantations along its track.

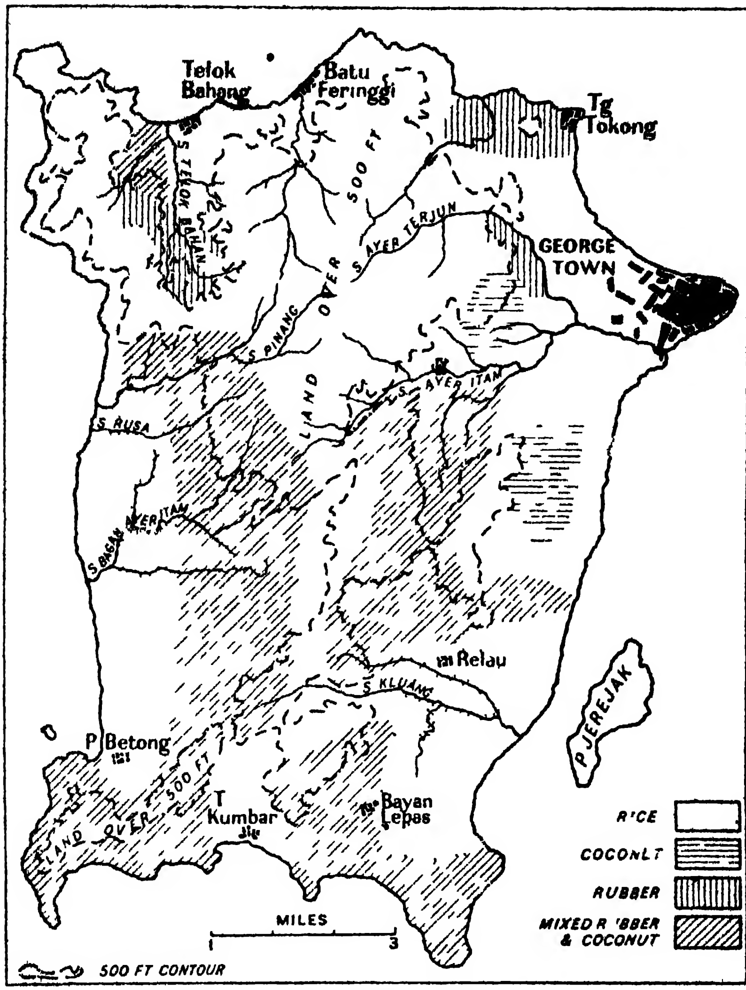

FIG. 45.—Penang . Land Use and Relief

(*d*) The Trengganu Highlands, an isolated, almost uninhabited, forest-covered area has only been developed by foreigners on the easternmost fringe where the Dungun-Kemaman iron mines until the war exported to the coast, as does the big tin mine of Sungei Lembing behind Kuantan, all employing Chinese or Indian labourers.

(*e*) The Pahang-Rompin Valleys, including the Pahang from Jerantut southwards and the Sungei Bera. This is an isolated,

undeveloped, thinly populated area. Along the middle and lower Pahang, Malay villages have evolved a little subsistence paddy farming between the riverside levees and the marshes adjoining them. The Pahang itself is a transport link, though its traffic has no great commercial significance.

(*f*) East Johore, a zone of hills isolated by marshes and very thinly populated, had in the inter-war period developed tin mines (behind Mersing), iron mines (near Endau), and rubber plantations towards the south. The original outlet from these production points was the east coast, but roads to Singapore increasingly carry tin and rubber in that direction. Chinese labour preponderates.

The roughly E-W. lines of the Muar-Simpang Kanan-Endau river marshes virtually isolate south Johore from both Western and Eastern Malaya. This isolation was significant historically and in our own times and might justify delimiting Johore as a region transitional between Western and Eastern Malaya and forming the immediate hinterland of Singapore, towards which Johore's roads and railways converge.

Singapore

While the physiography and development of Malaya have been centrifugal in their effects on the peninsula, Singapore may be described as representing the climax of routes and relations centripetal to Southern Malaya, though it is only since 1811 that these influences finally focused in Singapore itself, being centred in Palembang, Malacca, Batavia and Penang at previous periods in history. For over sixty years from the year Raffles took it over as just one other of those almost unpopulated, undeveloped and unproductive little islands scattered thinly south of Malaya, Singapore in fact was concerned with nothing else except trade upon the basis of these centripetal influences, which made it the port of call and of interchange for Indian, Chinese, European and East Indian commodities; during that time Singapore was solely an entrepôt. Later, Malayan tin came into its commercial sphere, yet this was for a long time just one extra aspect of the entrepôt trade. As Malayan tin and rubber came into world-wide prominence in the present century, trade in these products originating in Malaya began to pass almost entirely through Singapore, establishing the port as the tin and rubber market for the world, gradually drawing

to itself more of these commodities as the East Indies and other parts of Southeast Asia imitated Malaya's successful innovations and added them to their stream of trade with Singapore. On this basis, Singapore was started as a free port and has remained so, the fiscal dues on Malayan trade being paid at the Johore Strait and not in Singapore itself, which was not in fact linked to the

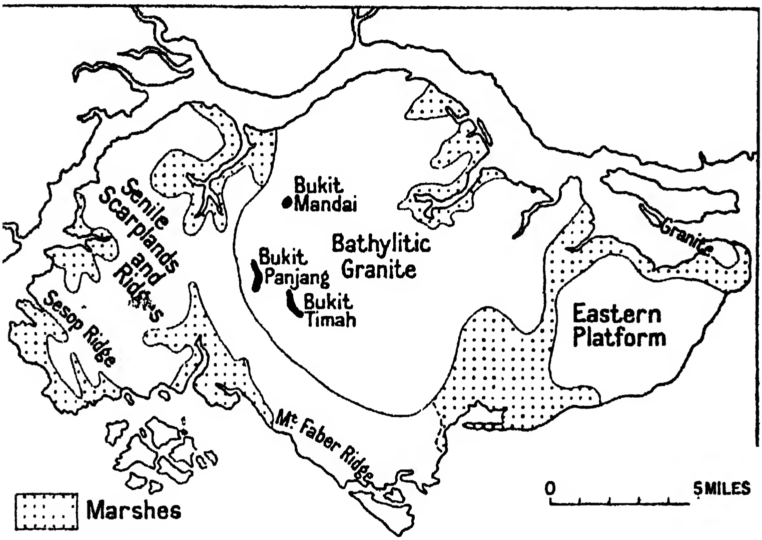

FIG. 46.—Physical Features of Singapore Island

peninsula by causeway until 1918 and is even now administratively distinct from it. There was no sustained success in cultivating pepper, spices or rubber on Singapore Island which has increasingly concentrated on its commercial life.

Within four months after establishing his port at Singapore, as another development in the rivalry of British and Dutch East India companies, Raffles reported the arrival of 5,000 Chinese, whom he deliberately encouraged because he thought their business-like astuteness and hard-working character fitted well with British mercantile interests, and because he had an eye on the China trade and the part Chinese merchants were already playing in the trade of the archipelago. It was, in fact, something of a paradox since the main interest of the British East India Company was India, from which base Singapore was controlled until 1867.

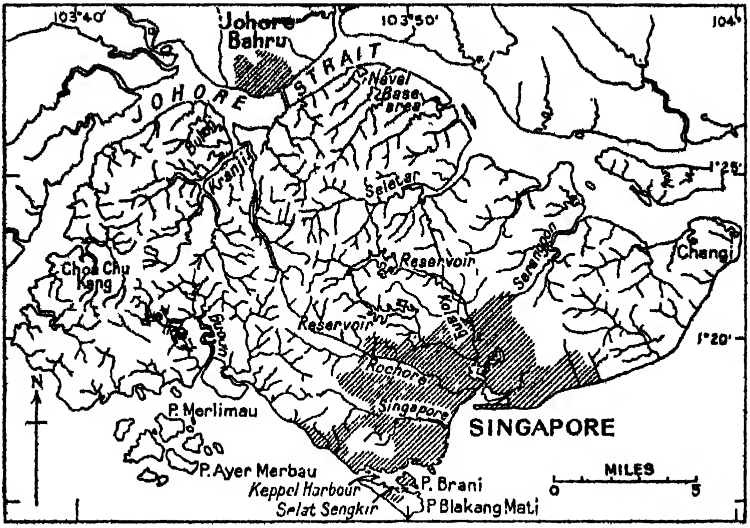

FIG. 47.—Drainage Pattern of Singapore Island

The accompanying maps (Figs. 46, 47, 48) summarise the geographic facts about the island (area 220 square miles) and show how it subdivides into three parts on the basis of physical and land utilisation differences; these are largely delimited by deep mangrove indentations. The central and eastern portions of the island have been tending for years to become largely urbanised as a result of rapid expansion of the town towards the south and towards extensive buildings at the naval base on the northern side and at Changi, an air base in the extreme east. Even the western side is coming more and more into the urban sphere, which has increased steadily through the last twenty years. Before 1941 the civil population of the island was about two-thirds of a million; in 1947 it became nearly a million.

The town itself is built on the rectangular street pattern common to most pioneer towns of the peninsula, with house forms and layout very westernised in character though the population is nearly 80 per cent Chinese. To these, the focus of activity is the waterfront where dozens of ocean-going vessels and hundreds of small inter-island ships are always assembled, some transhipping offshore, others by the quayside—for Singapore has the deepest harbour and dock facilities within a thousand miles radius, as well as elaborate warehouses and a complicated network of predomin-

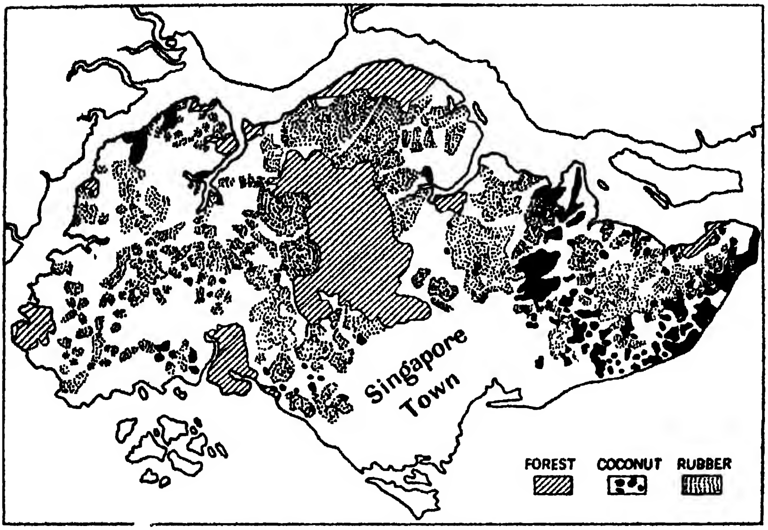

Fig. 48.—Land Utilisation on Singapore Island

ately Chinese shipping lines, both steam and sail, connecting it to all Southeast Asia and the archipelagos. Its street life is Chinese but dressed European; its commerce is largely Chinese, but the communal language is English, supplemented by bazaar Malay, though newly-immigrant Chinese still use their own vernacular.

Singapore's trade follows well-defined lines. On the normal figures of the immediate pre-war years, it was to be noted that the railway freight from Singapore to the mainland was nearly eighteen times that from the mainland to Singapore so that it was characteristically a one-way flow. Tin came in by road more than by railway. Nearly half of Singapore's imports came from the East Indies, consisting largely of oil, tin and rubber for re-export. Commodities such as manufactured goods from Europe and the United States, the most prominent single item being cloth, are imported in bulk by European firms, but their distribution retail in Malaya and the adjoining territories is by Chinese and Indian dealers. While tin smelting for most nearby territories is done by Singapore smelters, it is little evident in Singapore itself because the smelter is on a small island outside the harbour (Pulau Brani). Singapore has always played a considerable part in the financing of rubber without processing it. In few cases does Singapore add anything like a stage of manufacturing to goods passing through; its

function is that of handling, forwarding, shipping, reshipping, breaking bulk, sorting, grading, distributing and collecting. Its commerce is one of go-betweens, middlemen and carriers, with profit more from commission than from processing. In addition Singapore handles the distribution of food, and other daily needs of the mining and plantation workers; it handles huge quantities of rice from Burma and Siam, minor Chinese foods from China, dried fish from the islands and cotton textiles from Britain, India and the Far East. During postwar years, Singapore's gross trade overseas has averaged about $2,000 million annually, rubber, rice, cotton textiles and tin being the chief items, in that order; about a quarter of this trade has been with other Southeast Asia territories and about half with Indonesia, U.S.A. and U.K. together. In 1950, its trade reached a total of nearly $7,000 million.

Chapter Nine

THE NATURAL LANDSCAPE OF BURMA

MALAYA represents an example of Sunda Platform environment; Burma exemplifies conditions marginal to that Platform and to the Himalayan systems, a region transitional in type between geographical environments of Southeast Asia archipelagoes, of mountainous Western China, and of India.

PHYSIOGRAPHY

The physiography of Burma, less simple than it appears at first sight, and particularly complex in the human reaction to its various parts, is laid out with a relief-pattern shaped like an asymmetrical inverted V.

(*a*) The relief stems from a nameless mountainous core north of Putao, rising to heights of more than 20,000 ft. as a complex structural knot where the typical W-F Himalayan trend lines branch into a great loop of fold systems which run southwards on a great arc, forming the mountain system of West Burma (mainly the Arakan Yoma), and thence as the southern and western margins of the Sunda Platform in Sumatra and Java.

(*b*) On the extreme east are the Shan Highlands; from the Putao Knot mountainous relief continues southward into the Shan Highlands, though the orographic continuity has no basis in structural uniformity.

(*c*) Between the Western Mountains and the Shan Highlands lies the Irrawaddy Basin, broadening and sloping southward to become the Gulf of Rangoon.

(*d*) Modern Burma as a political unit tapers towards the Kra Isthmus, where the ranges *en echelon* of the Malay Peninsula are repeated northward to merge into the Shan Highlands; this isthmus section of Burma is Tenasserim.

Thus there is a triple physiographic division, the Western Mountains, the Shan Highlands and their continuation into Tenasserim, and the Irrawaddy Basin (Fig. 49). Of these the best studied, the most elaborately developed and highly organised is the Irrawaddy Basin.

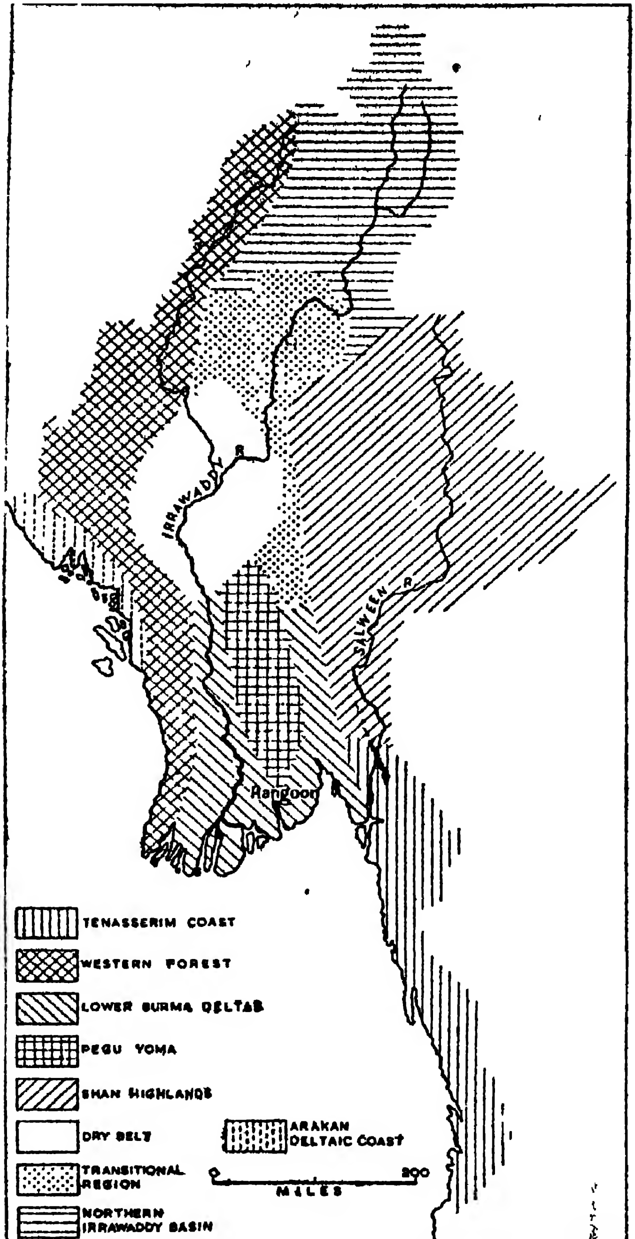

FIG. 49.—The Regions of Burma

1. *The Western Mountains*

The knot north of Putao is complex but its form lines in Burma run predominantly N-S. The thinness of peopling and poor development cause it to be more interesting geologically than geographically, though it has functioned as a bridge for peoples moving from Asia southwards.

More significant for Burma is the main Western Mountain group (highest peak, Mt. Sarametti, 12,557 ft.) through which runs the India-Burma border. This arcuate set of ranges which includes the Arakan Yoma and is mostly above 6,000 ft., is broad to the north, tapering in width southward to become Negrais Point and later a submarine section, showing above the sea as the Andaman Islands. It is largely a series of parallel ranges through which rivers have in places cut transverse valleys to produce a trough and cluse drainage-pattern resembling a trellis in plan. To the north the ranges are called the Patkoi, Lushai, Naga, Manipur and Chin Hills, becoming more compacted at the centre as the Arakan Yoma. Between the Patkoi Hills and the Arakan Yoma is the intermontane basin of Manipur, lower than the surrounding country yet called "The Highland of Manipur," an important channel of entry of ethnic groups moving into Burma. Some of the mountain masses are possibly fragments of older structures caught up in the western mountain building processes. In its northern section, this unit on the east breaks sharply to the Hukawng alluvial valley, but the Arakan Yoma proper abutts an area of hilly dissected upland shaped from pitching synclines to produce in places a series of boat-shaped scarps as in the Lower Chindwin. The Arakan coast, a group of narrow alluvial flats laid down by short, violent streams, and dominated by forest-clad hills often reaching to the sea as cliffs, is of the type called "Pacific Coast," where the fold-structure lines parallel the coast. Though the northern end has considerable heights, glaciated relief is found only north of latitude 27° and has not been proved to exist in the Arakan Yoma itself.

2. *The Shan Highlands*

A deeply dissected plateau, the Shan country, averaging 3,000 ft. high, rises abruptly, often in single steps of 2,000 ft., from the Sittang-Irrawaddy Basin. It is, however, intensely folded on N-S. lines and consists of rocks and structures much older than most in

Burma and more closely related to those of the Sunda Platform; great stretches of massive limestone, sandstones and metamorphic rocks and granite repeat on a larger scale at sustained higher altitudes the rock types and relief forms already described in Malaya. Granites are not prominent at the surface of the structures here in Burma, except to the south and on the western fringe where the Highlands narrow and break down into the Tenasserim Ranges lying skew-wise to the Isthmus. The Shan Highlands merge northwards into the mountainous uplands dissected on N-S. lines by deep river gorges, a landscape which increases in altitude to the Putao Knot and extends eastwards through Siam and beyond the Mekong into Laos. Over large areas the compact limestone provides excellent examples of landscape, developed on this relatively soluble rock, whose usual valleys are broad, shallow and with gently sloping sides, now undergoing solution; through them streams meander sluggishly, often edged by marshes. Where several streams combine to give a powerful flow of water, down-cutting exceeds the rate of solution of the sides and leads to narrow gorges choked with masses of limestone fallen from the precipitous sides. Sometimes the dissolved limestone is redeposited from the groundwater to form travertine or calcareous tufa which looks rather like pumice; should this form rapidly, a natural dam may be built up. Later the stream will break this dam and take another course, resulting after a time in a network of small watercourses, not all of them full, surrounded by marshy ground—as at Hsum Hsai on the Mandalay-Lashio railway. Enclosed drainage basins (polje) are also very common, together with the other evidence of subterranean river systems. Extensive limestone caves are found at Moulmein, Kalaw, Gokteik, Singgu (above Mandalay) and Myitkyina.

3. *The Irrawaddy Basin*

Located between the two higher landscape types to the east and west, the Irrawaddy Basin, while also primarily a folded structure, though of less amplitude, has in addition the remnants of local volcanic land forms. It is by no means merely a large river valley or an old gulf of the sea: its rocks and structures are distinctive and in places of great thickness, considerable age and of successions peculiar to this area, so that there are special rock groupings called the Irrawaddy Series and the Pegu Series. Though partly concealed by terraces of Chindwin, Irrawaddy and Sittang river alluvials, the

folded substructure of this Basin appears dissected at the surface in the Pegu Yoma which runs lengthwise through the middle, from the Myingyan District to the low ridges overlooking Rangoon, continuing far northward as a double line of dissected hills across the Irrawaddy and Chindwin rivers as the Sagaing-Mingin-Zibyun hills. Originating in connection with the folding of the Pegu Yoma and their extensions in the northern hill ranges is the line of extinct volcanoes now showing as the eroded cones and lavas of Mount Popa on the northwest flank of the Pegu Yoma, of Wuntho's jade mining district, and of Taungthonlon in the Mingin Hills. Once thought to be a tectonic rift flanked by faults, the Basin is accepted as mostly a fold structure, developed on alternating beds of clays, shales and sandstones, the varying characters of which produce great variations in the surface according to their exposures.

The Irrawaddy Series of rocks consists essentially of sands with subordinate conglomerates and clays which have been folded and eroded into a landscape of strike ridges and valleys. In the Dry Zone round the Chindwin-Irrawaddy junction, the series is capped by looser gravels and lateritised soils over a wide area (Fig. 56).

The Pegu Series includes thick, massive but easily eroded sandstones forming long continuous escarpments on N-S. lines, the lowest sandstone forming the impressive scarp overlying the Ponnyadaung Range, clays and shales with thin interbedded sandstones forming low ridges above clay lowlands (as at Pyawbwe). The Pegu and Irrawaddy Series of folded, younger rocks have produced under erosion some of the best Southeast Asia examples of scarped landforms.

Farther south over the Basin are spread alluvial deposits of many types and thicknesses, varying in character from coarse gravels near the hills to fine clays and silts towards the centre and south. While these deposits, interpreted by de Terra as a succession of river terraces, vary too much for generalisation, their different qualities and texture condition the pattern and intensity of cultivation.

Climate

Several factors modify in Burma those climatic influences common to most of the rest of Southeast Asia.

1. Higher latitudes and altitudes and more continental location produce in parts of Burma lower temperatures than those normal for Southeast Asia, so that freezing in January may be met

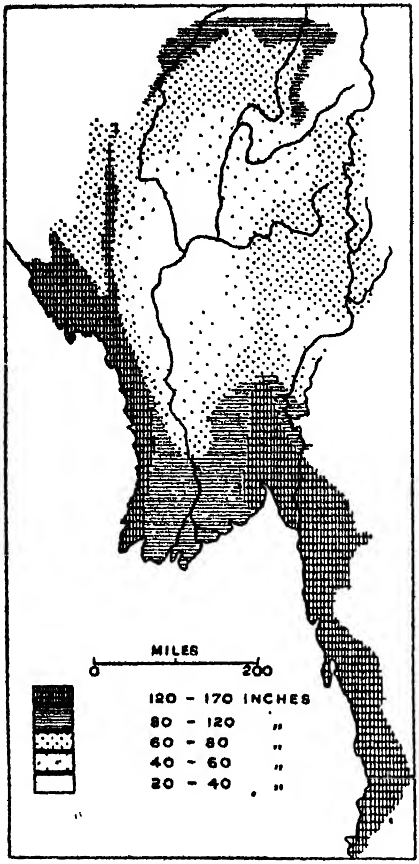

Fig. 50.—The Rainfall of Burma

on altitudes over 3,500 ft.; the Shan Highlands experience light frosts at that time and higher still, above 10,000 ft., farther north, snow falls for about two months a year. A cool season is noticeable throughout Burma.

2. A distinct dry season occurs in most districts except where on the coastal fringe or on uplands local influences may cause sufficient precipitation to minimise the drought. The dry season tends to be more emphatic in areas where annual precipitation is lower than the average for Burma. Rain comes on with the abrupt violence characteristic of an Indian monsoon, starting fairly generally towards the end of May and ending in the third week of October. During the dry season sunshine periods and temperatures are high, until the coming of the rains brings a sharp drop in daily maxima which are highest in April and May.
3. The N-S. arrangement of the relief runs athwart the airstreams sweeping over Burma, so that the central Irrawaddy Basin is in a rain shadow for most of the year and has a Dry Zone of elongated, lobate shape roughly centred on Pagan. The dryness of this zone is emphasised by föhn winds produced as the airstreams move into it from the Arakan Yoma and the Shan Highlands. When rain does fall in the Dry Zone it comes chiefly from southerly sectors of the summer airstream.

Relief dominates the pattern of rainfall (Fig. 50). During the period of southwesterly winds, the warm damp air masses impinge

on the Western Mountains and the isthmus coast to produce heaviest rainfalls in Arakan and Tenasserim where over 200 in. per annum may be recorded. On the eastern flanks of the Arakan Yoma at that time considerably less rain falls, but precipitation increases again in the eastern highlands. Northern Tropical Air, in this latitude flowing over Burma in winter, is not particularly rainy except where altitude induces precipitation in the eastern highlands and on the western side of the Irrawaddy Basin.

MONTHLY RAINFALLS (in inches) AND PREDOMINANT WINDS OF MONTH

	Aver. No. of rainy days	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Rangoon ..	122	.2	.2	.3	1.4	12 0	18.0	21.4	19.4	15.3	6.9	2.8	.4	98.3
		NNE	NNE	SW	WSW	SW	S	SSW	SSW	SW	NE	NNE	NNE	
Thayetmyo ..	73	.1	.1	.2	.8	4.5	6.7	6.8	6.5	6.1	4.1	1.7	.2	37.8
Moulmein ..	139	.2	.1	.5	2.8	20.3	37.2	46 2	43.6	27.7	8.7	2 2	.3	189.6
Mandalay ..	51	.1	.1	.2	1.1	5.8	5.5	3.3	4.6	5 7	4.7	1.6	.4	33.1
		N	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SE	NE	N	
Minbu ..	57	0	0	.3	.8	5.6	5.7	4.5	5.3	6.2	4.5	1.8	.5	35.3
		NW	NW	SE	SE	SE	SE	SE	SE	SE	SE	NW	NW	

The Dry Zone, focal area of Burmese life and development, has much of its scanty rain (in places less than 25 in. per annum) concentrated in a few torrential storms (Fig. 52). Moreover the fall is less reliable here than elsewhere in the country, a critical factor since the most elaborate and complicated agricultural development has taken place in the Dry Zone. The unreliability of rains has been countered to some extent from the human angle by a diversified agriculture so that whatever the particular rainfall of one year, at least one crop may be expected to be satisfactory. Fine clear weather, with many calms, continues from November to March though in river valleys morning mists may lie; during the rains (June to September) which reach the Dry Zone rather later than elsewhere, winds are weak and daily cloud densities are high. Violent thunderstorm-rains arrive in May and October. While the Dry Zone is strictly confined to Inner Burma, the tendency to drought is apparent even in the Irrawaddy Delta (Fig. 59) which has a longer dry season than either Arakan or Tenasserim. On the Delta, rainfall diminishes rapidly inland from 200 to 100 in. per annum at the coast, to about 40 in. inland; at Thayetmyo rainfall is 38 in. per annum, and at Prome 47 in.; July is the rainiest month and December-March the driest season.

During the period November-May cyclonic disturbances streaming across northern India eastwards cause minor deteriorations of

the otherwise fine weather over northern Burma. Minor depressions from the South China Seas sometimes cross north Burma from July to September, producing local rains. Tropical cyclones also move over the Bay of Bengal between April and December, moving westwards away from Burma but occasionally striking the Arakan coast. In the last sixty years, the totals of tropical cyclones of various intensities striking the Arakan and Martaban coasts were:

Season	*Arakan*	*Martaban*
December-March	—	—
April-May	21	15
June-September	2	1
October-November	24	—

In Burma, close correlations between climate and tropical diseases have been demonstrated. Inland, malaria increases in the wet season but on the coast it is more frequent in the dry season. Cholera is a feature of the early rains, while smallpox reaches its peak at the end of the dry season. Dysentery peaks are associated with disrupted sanitation during floods early in the wet season.

Drainage Patterns

While two-thirds of Burma's surface drains into the Irrawaddy, which therefore ranks as by far the most important Burmese river system, there are several subsidiary river systems.

Arakan Rivers

The Kaladan, Lemyo, Mayu and Naaf rivers flow on N-S. lines separated by abrupt, high and forbidding watersheds related directly to the fold structure. Their courses become trellis patterns and they have all built broad deltaic forms at the coast where the streams debouch after taking sharp bends out of the structural alignment. Apart from the lower zones of sedimentation, tending to delta form, though much flattened against the coast by onshore winds, the streams are immature and unusable for navigation, except the Kaladan which can be used almost to Paletwa. These streams rank as important because only on their estuaries can settlement reach any great density. Their headwaters lead to the passes through the Arakan Yoma which have had negligible modern significance.

Tenasserim Rivers

On the Burmese part of the isthmus, relatively short streams follow lines resembling those of Malaya, between ranges slightly skew to the coast and continuing out to sea as a string of offshore islands which has facilitated coastal sedimentation (Fig. 55). Often the rivers, while otherwise mature in form, pass through narrow rocky gorges at gaps in the ranges. Tenasserim streams frequently make right-angled bends to reach the sea. As in the case of the Arakan streams, these are short tropical streams bringing heavy silt loads in their fairly constant flows and the rate of coastal sedimentation is rapid. Some were used by earlier merchants for harbourage and a trans-isthmus route, but most are no longer usable even for sailing craft. A fluvial sorting of the sediments, varying from gravels to fine silts, may be observed from the ranges to the coast and in Tavoy the gravels are tin-bearing under much the same physical circumstances as in Malaya.

The Salween River

Paralleling the Irrawaddy for much of its course, the Salween crosses the Shan Highland in a series of deep gorges whose lengths are unequalled even by the Yangtze gorges. Coming from Tibet, the Salween draws close to the Mekong and Yangtze, all three lying within 42 miles of one another at some points.

Until it reaches the Shan country, the Salween has no tributaries apart from torrents, but there it receives many streams as much as 300 miles long. Its deep, rocky trough-like valley reaches within 50 miles of the sea, so that the Salween's erosive power remains strong almost to the coast. The greater incision of the Salween compared with the nearby upper Mekong is due to its greater rainfall; the narrowness of its long, ribbon-like drainage basin is thought to be due to encroachment and capture of its tributaries by neighbouring rivers, of which the Irrawaddy and Mekong have been particularly active as captors. Many Salween tributaries, of which the largest are the Yungzalin, Gyaing and Attaran, enter the parent stream with a cataract or cascade, caused partly by more intense erosion by the main stream, partly by the enormous variations of water level in it. The average seasonal change of the Salween level is 65 ft. which dams tributaries and induces them to drop gravels and boulders not far from

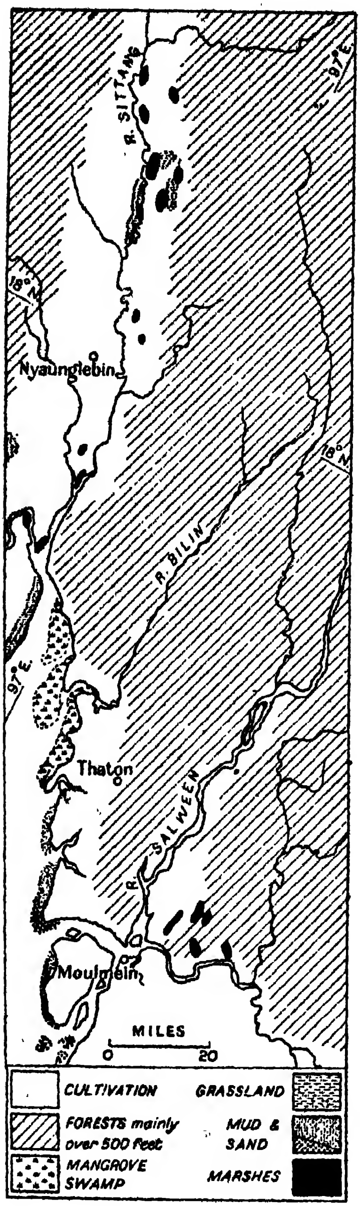

Fig. 51.—The Sittang and Salween Deltas

the confluence. Despite its size, the Salween has so broken a course, is so deeply incised and suffers such enormous changes in level that it is probably the least useful major river in Burma. Its only value has been for floating teak logs, yet it might with major engineering works be made a source of hydro-electric power. A quick and constant building of shoals and bars with a resulting frequent change of distributaries goes on at its mouth (Fig. 51) which is becoming silted up beyond possibility of use as an entry for steamers, though its outlets near Moulmein were extensively used for harbourage earlier this century. The great volume of the Salween in spate is the cause of inundations in rivers like the Attaran, an otherwise stable stream in a mature valley. During the rainy season, when the Salween runs faster than its choked outlet can discharge, widespread floods develop behind the coast.

At Inle, between the Salween and Irrawaddy watersheds, is a small area of inland drainage into a lake 14 by 4 miles at 3,000 ft., varying greatly in depth according to the season. It drains southward but the outflowing streams quickly disappear into a limestone substructure probably to discharge ultimately into the Salween.

The Irrawaddy River System.

In the Irrawaddy Basin we see the effects upon drainage pattern of subdued tectonic foldings which took place on a landscape where a complete river system had already been established. Following the upfolding of the Pegu Yoma, two streams drained into the basin:

(*a*) A western stream, formed of what is now the Chindwin, together with that part of the Irrawaddy below Pakokku; this river has been named the Proto-Irrawaddy.

(*b*) An eastern stream, formed of the present Irrawaddy above Mandalay continued south into the present Sittang, to constitute the Proto-Sittang.

The capture of the headwaters of the Proto-Sittang by the Proto-Irrawaddy near the great bend at Mandalay seems to have resulted from structural warpings within the basin and from an outburst of volcanism, which has now become extinct (Stamp). The Sittang (Fig. 56) neatly demonstrates the normal symptoms of capture, i.e. conformity between its profile with the Upper Irrawaddy, irregular and reversed drainage near the elbow of capture, disproportion between the Sittang stream and the alluviated valley it now occupies, and a much reduced vertical erosive power of the river. Rapid silting up of the Sittang still goes on as a result of cultivation and forest clearing, so that while forty years or so ago the river at Toungoo averaged 18 ft. deep, it now averages scarcely 3 ft. and the water has been forced to fan out to at least double its previous width (Fig. 51).

The Irrawaddy itself varies so much in different parts of its course that its features will be best described in subdivisions:

(*a*) The Irrawaddy above "the confluence" (north of Myitkyina) does not carry that name. Two mountain streams partly draining the southern snows, the Mali Hka and the Nmai Hka, combine at this confluence. Of these the Mali seems the maturest and is probably an antecedent stream.

(*b*) From the confluence to Bhamo, the name "Upper Irrawaddy" is used. Over this 150 miles the current is usually strong yet permits navigation, except at a dangerous point below Sinbo where the river enters a gorge only 50 yds. across and becomes violent and dangerous (known to rise as much as 80 ft. in one night). Through it passes water which even at low levels back

at the confluence is already a quarter mile broad and 30 ft. deep. The gorge (Third Defile) has over its 40 miles of length immediate cliffs of 60 ft. height between mountains over 2,500 ft. high. East of the defile and paralleling it, is a broad, low valley, once the Irrawaddy watercourse. Why the river was diverted from it to the present defile has not been convincingly explained.

(*c*) At Bhamo the Irrawaddy spreads across an alluvial basin about 12 miles broad, and this plain continues as a bend to the west.

The Irrawaddy takes a different bend to the west, avoiding the plain and passing into its Second Defile through a massive limestone. Here the gorge is sometimes 250 ft. deep and 100 yds. wide. Again this entry into a gorge and evidence of an easier alternative course cannot readily be explained; Stamp suggests it evolved not as a drainage line antecedent to the present relief but as a capture by rivers originally underground in solution channels within the limestone. After this defile, the Irrawaddy re-enters the alluvial plain westwards to reach Katha, whereafter it resumes its southerly course. From its source to Katha, the Irrawaddy is broadly antecedent to existing structural forms.

(*d*) From Katha to Mandalay the Irrawaddy follows a strike valley. East of it are the crystalline hills of the Shan Highlands which thereafter continue southwards in almost a straight scarp as much as 2,500 ft. high for about 500 miles to the sea, probably representing a faulted limit of the Sunda Platform and conditioning the pattern of the Proto-Sittang. Near Thabeikkyin the river enters a sandstone gorge (First Defile) whose sides are forested and less precipitous than the other defiles. At Kabwet a lava sheet, probably poured out in historic times, has diverted the river to the west, which after it rapidly widens southward to the Mandalay Basin, where a few crystalline hills (outliers of the Shan Highlands) occasionally show through the alluvials as inselbergen. The one bridge across the Irrawaddy at Ava was built to benefit from a local inselberge.

The great swing westwards of the Irrawaddy near Mandalay in preference to what appears an easier route southward to the Sittang is one of those puzzles so often associated with capture processes. The swing may have been connected with that period of vulcanism producing Mt. Popa which, rising now to some

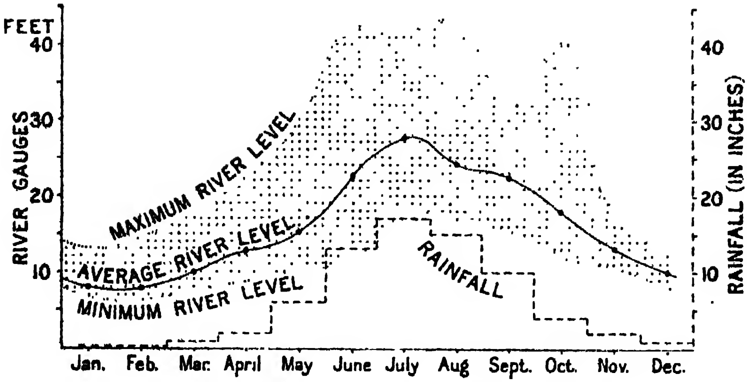

FIG. 52.—Régimes of the Upper Irrawaddy

5,000 ft., overlooking the Irrawaddy from the south, was still active a few centuries ago. At its turn the Irrawaddy has a huge discharge of water (about 900,000 cusecs – cubic feet per second—for ordinary wet seasons).

Chief focus of the Burmese people and their tradition, Mandalay is clearly located as a convergence centre and dominating point for human movements in the Chindwin-Irrawaddy-Sittang valleys, and from the valleys through the Shan country.

(*e*) From Mandalay to Thayetmyo, the Irrawaddy passes through the Dry Zone, a landscape where low terraces and degraded scarps flank the flat Irrawaddy alluvials and generally stand up sharply without much vegetation (Fig. 56). The long dry season and the violence of a few rainstorms each year make this zone one of powerful erosion, producing "bad lands" terrain whose deeply scored hillsides witness the heavy load of silt which each storm adds to the Irrawaddy. Many side streams here are dry for most of the year, to become seething torrents of dirty brown muddy water within a few minutes during the brief wet season. Throughout this Dry Zone, the evaporation rate is high, so that the river volume is not usually very great, emphasised by the fact that the river is here losing grade because it is less than 200 ft. above sea level and has over 450 miles more to go to reach the sea.

(*f*) From Thayetmyo to the Akauktaung Ridge below Prome, the Arakan Yoma and Pegu Yoma approach one another fairly closely and spurs from both lie across the Irrawaddy Valley,

which narrows and becomes more variegated because pockets of alluvial terrain, reminiscent of the Mandalay area, alternate with steep rocky sections recalling the Upper Irrawaddy; in one of the narrower sections stands Prome, a key river port. Some 90 miles below it, the Irrawaddy begins to subdivide into its first distributary, the Bassein River. Even below this, however, sandstone cliffs still occur to constrict the river, and the valley section continues to Myanaung, the apex of the delta.

(*g*) The delta, 180 miles from north to south and fanning to a width of 150 miles at the coast, is covered by a complicated braiding of distributaries which merge, subdivide and recombine until nine mouths empty into the sea. Most water passes out through the Eya mouth. While the Bassein and Rangoon rivers connect with the Irrawaddy distributaries, they are really separate streams, the Bassein draining the southern Arakan Yoma, the Rangoon River the Pegu Yoma, whose respective deltaic fans have merged into the main delta. The delta is less noteworthy for its flatness and more for its low altitude; about 2,000 square miles (of its total 12,000 square miles) are below high spring tide level and another 2,000 square miles are only one foot above that level. The heavy rainfall in violent showers and the fineness of the silts which form this landscape combine to produce rapid erosion of the deltaic surface despite its being so little above sea level. Hence the surface is not being built up vertically, especially where cleared for cultivation, but it is extending horizontally seawards at about 3 miles per century (about 50 metres per annum) as lines of spits built by onshore drift from deltaic sediments are fixed by vegetation growing upon them, so that the lagoon or creek behind each spit becomes gradually filled by mangrove to rise above sea level by the process explained in Chapter 4. Thus the landscape has a very low relief, slightly modelled by levee banks arranged radially across the delta and parallel to the distributaries, and by lines of casuarina-covered low ridges paralleling the lobate coast, the vestiges of old spits now continuous with the mainland.

Tributaries of considerable complexity resulting from an interaction between antecedent drainage lines and the tectonic drainage lines of the present Basin, join the Irrawaddy above Mandalay. These, of which the Shweli and Myitnge are the longest, have

highly irregular courses with frequent captures, diversions and gorge features.

The Chindwin (drainage basin 44,000 square miles) is, however, the main tributary of the Irrawaddy. Its headstream in the Hukawng Valley rises close to the Upper Irrawaddy, and then moves westwards in a great arc with frequent rapids and waterfalls until it takes on the southerly course which it maintains until it joins the Irrawaddy in a group of distributaries and a landscape like an inland delta. Such a form at the junction indicates the loss of grading experienced by the Chindwin on reaching the Irrawaddy Valley. The Upper Chindwin runs through a wide syncline flanked by bold scarps, mostly fan fold structures, though there is a great fault line east of the Shwebo Hills; north of Kalewa the river has scarp falls to the east and dip slopes on the west. Near Mingin the Chindwin breaks out of the tectonic basin it has flowed through and penetrates scarps to reach a depression between the anticlinal domes of Medin and Palusawa after which its southward course as a calm wide stream is interrupted only near Shwezaye where barriers of volcanic ash from extinct volcanic craters, on either side of the river, for some miles constrict the Chindwin into a narrow cliffed channel.

Forests and Vegetation

Tropical Rain Forest covers the whole length of western Arakan Yoma, the southern part of the Pegu Yoma, the western edge of the Shan Highlands overlooking the southern half of the Sittang Valley, a narrow belt astride the Salween as far north as 25° N., and the whole of Tenasserim (Fig. 53).

The 80 in. isohyet chiefly delimits forms of deciduous (monsoon) forest containing ironwood (Pyinkado, Xylia dolabriformis) and teak. These have sparse bush and ground vegetation giving an open aspect, and they are mixed with some evergreen trees and bamboo, almost ubiquitous in Burma. Two types of teak forest have been distinguished, the drier one with thickets of bamboo and a wetter type, source of most commercial teak, in north Tenasserim, Pegu Yoma, and near Bhamo and Katha in Upper Burma. Where heights increase, this type of forest merges above 3,000 ft. into one dominated by oaks. Conifers appear on the higher Arakan Yoma and over the Patkoi Ranges.

Savannah mixed with forest, the effect of porous subsoils and

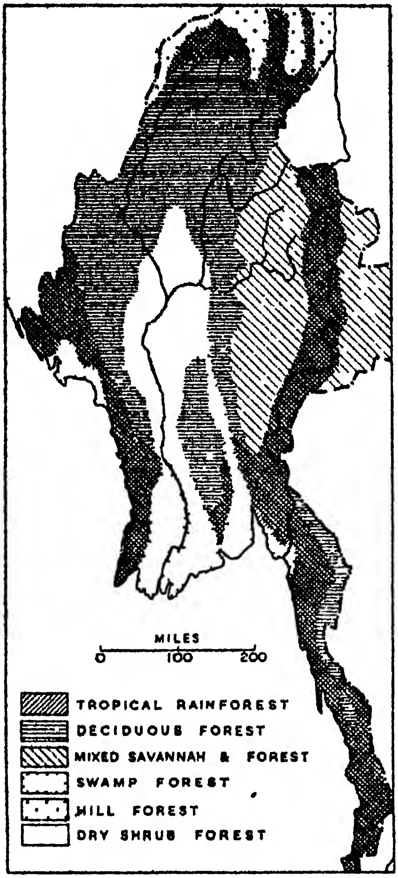

FIG. 53.—The Vegetation of Burma

overcutting by shifting cultivators, is very extensive over all the Shan Highlands.

The Dry Zone of the Irrawaddy Basin has dry scrub forest within the 35 in. isohyet. A form of ebony (Diospyros) in stands pure enough to be attractive commercially, extends through the Yaw Valley west of Pakokku. South of Mandalay, particularly on the Pegu Yoma, low-branching short types of trees, the teak species and acacias grow, with some cycads towards the wetter limits. At the middle of the zone short thorny acacias and euphorbias are most common, with toddy palms (palmyra) along water lines.

In the far north, altitude and a more continental climate induce a "rhododendron forest," where rhododendrons, magnolias and maples are common, together with firs and tall Formosan pines. Even here, above 8,000 ft., scattered short bamboos persist. Higher still this forest merges into an alpine vegetation of mossy heaths, dwarf junipers and rhododendrons, and a wealth of small evergreens and perennials.

On the coasts and over the deltas, the mangroves and swamp vegetations repeat features common to similar parts of Southeast Asia.

Commercial Work of Forests

Teak and ironwood constitute the bulk of commercial timber extracted in Burma, where, however, there is in addition

considerable local use of many other timbers. Bamboo and various palm leaves are prominent in Burmese domestic life.

Teak, known to Burmese as *Kyun*, occurs over large areas and has proved to be one of Burma's valuable commercial assets, capable of sustained annual yields of over 400,000 tons of timber. The main areas exploited are the Tharawaddy-Prome forests, Pyinmana, Toungoo, Katha, Shwebo, Chindwin Valley, Myitkyina, Minbu, the Shan Highlands, and the lower Salween. Careful planning of the extraction is made necessary by the scarcity of labour and the timing of spates for transport. Teak in most of these forested areas is hauled to water-edge by elephants and floated downstream. Waterways like the Irrawaddy, Sittang and Salween take down great rafts of teak during the rainy season from July to October, and deliveries of the timber at the chief commercial centre for it, Rangoon, normally go on through the period November-February. The assembling of teak rafts is done at Mandalay, Pakokku, Prome and Toungoo, and the milling into commercial boards mostly at Rangoon and Moulmein, though there were scattered local mills elsewhere along the rivers. Burma's production of round teak logs averaged 446,000 tons per annum over 1925-40. Some three-quarters of the teak exported normally goes to India and much of the rest to the United Kingdom. The total output of teak from all other Southeast Asia areas amounted to only one-third that of Burma in pre-war years.

Over the last twenty years the cut of other timber has exceeded that of teak but the other timber was mostly consumed within Burma. The output of timber seems less than proportionate to so forested a territory, but the difficulties of extraction are high and some of the best "other timbers" are heavier than water (e.g. *pyinkyado* or ironwood, invaluable for sleepers on tropical railways and heavy structures) and can only be floated if buoyed with other wood, which means it can only be floated down the deeper streams which give the suspended logs clearance. About 110,000 tons per annum of ironwood were cut over 1935-40 and Mandalay was chief milling centre for it.

Forests provide 20 per cent of the state revenue, which indicates that their significance for Burma is second only to rice cultivation. This front-rank importance of forest resources in Burma contrasts with the negative interest in the forests closer to the Equator, in Malaya and the East Indies.

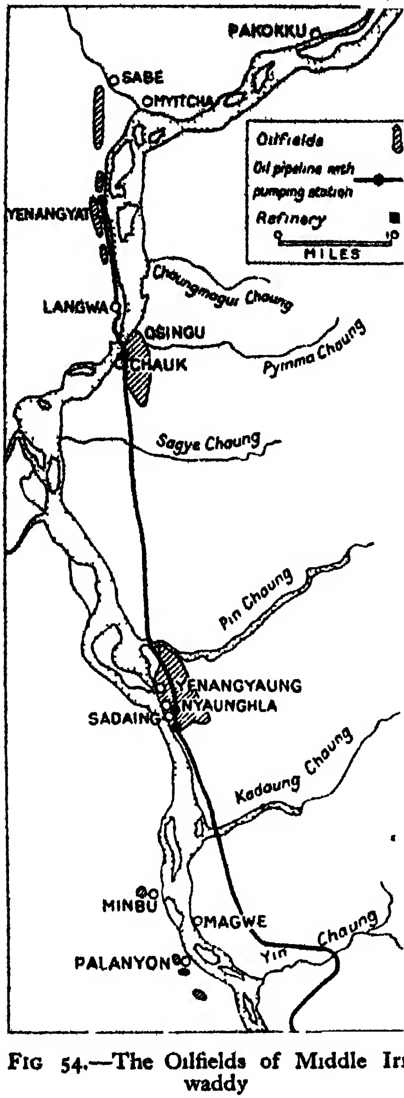

Fig 54.—The Oilfields of Middle Irrawaddy

Minerals

The absence of suitable coal has operated against attempts to industrialise Burma; low grade lignitic coals occur in the Northern Shan States, near Lashio and Namma and in the Arakan Yoma foothills near Minbu and Henzada. Burma's chief mineral is petroleum, found in the anticlinal and dome structures northwest of the Pegu Yoma where a line of oilfields from Indaw (Upper Chindwin) through Sabe (west of Pakokku) and Singu to Yenangyaung was being operated up to 1942 (Fig. 54.) The output of over 275 million gallons (1939-40) was piped to the Syriam refineries across the river from Rangoon. The output was small in relation to world production (less than 1 per cent) though located conveniently to supply India with petroleum and the Far East with paraffin and candles. Destroyed in the campaign of 1942, the wells are being slowly re-equipped for nationalised production which was barely 27 million gallons in 1947. A small output by crude methods dating back two or three centuries is still going on.

Precious stones, particularly rubies from the Mogok mines northeast of Mandalay, have a reputation in Burmese tradition, but no great commercial significance today. Following the older

Chinese workings, a modernised mining and refining system at Bawdwin in the Northern Shan States produced some 70,000 tons of lead-silver (one-sixth world total) almost entirely for export. Tin gravels in the western foothills of the granite formations in Tenasserim and Karenni (Fig. 55) repeat conditions found farther down the peninsula in Malaya; while east of Tavoy tin and tungsten occur together; between Mergui and Victoria Point the mines are exclusively for tin. Most tin concentrates (about 1,500 tons in 1950) went from Tenasserim to Rangoon and thence to smelters at Penang or Singapore. Alluvial gold in the Irrawaddy gravels near Myitkyina has ceased to be worth working.

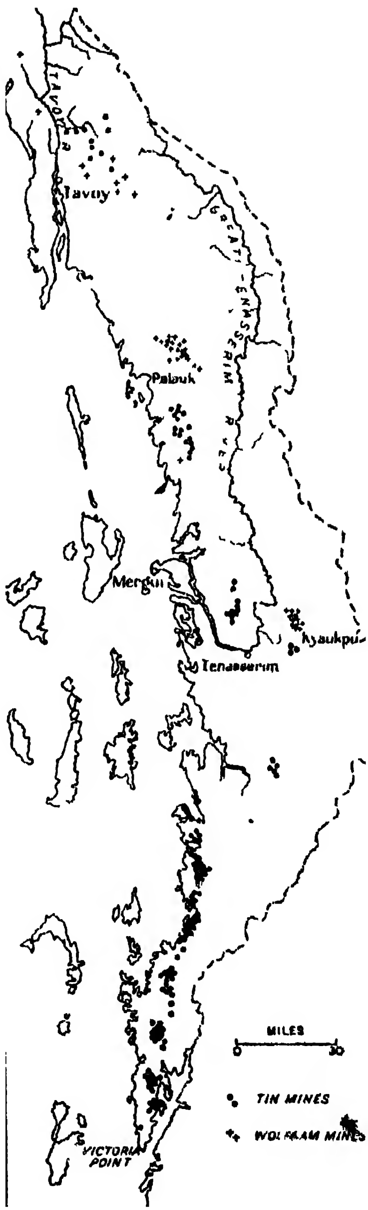

Fig. 55.- The Mines of Lower Burma

In total, Burma's primary mineral production is relatively small, not particularly important for the national welfare, and inadequate for industrialisation, more especially since the means of production were destroyed during the war. While there are great reserves of lead-silver at Bawdwin, it may be that the cream of Burma's other minerals has already been skimmed and that the likelihood of reviving these productions will remain low until methods of solving the labour difficulties are devised. These

are by no means new difficulties: Burmese agriculture faced labour shortages for most of the past century.

Soils

Burmese soils mostly repeat features common to Southeast Asia *pari passu*, except for those of the Dry Zone where climatic conditions are abnormal for this region. In the Dry Zone, while laterisation processes are apparent peripherally, high evaporation rates cause accumulation of solubles to be dominant in the topsoils. Two distinctive soil types have evolved in this Dry Zone:

(*a*) *Black Cotton Soil.*—Known as *tane*, it forms to depths of about 2 ft. upon some older Irrawaddy alluvials and is remarkable for its black colour (though when dry it may be straw yellow) which intensifies when moist. Its texture is claylike, though clay is not predominant in its composition (about 45 per cent) and its stickiness and tenacity derive from a high calcium and magnesium content which accumulates as the result of prolonged evaporation. Associated with cotton cultivation, and difficult to work, Black Cotton Soil occurs on either side of the Chindwin at Monywa and round Shwebo, and small patches are widely distributed through the central parts of the Dry Zone. Its retention of moisture makes it a reliable producer even during abnormally dry seasons and suitable for winter cropping.

(*b*) *Saline and alkaline soils* develop under high evaporation where the clay content is low; capillarity causes the accumulation of carbonates and sulphates of sodium, calcium and magnesium which colour these soils yellow or brown. Generally inimical to vegetation, saline soils develop southeast of Shwebo and in northern Sagaing where even salt lakes occur (Halin, Yemyet In). Saline efflorescences also appear round the Selingyi Volcanic Uplands.

Chapter Ten

THE CULTURAL LANDSCAPE OF BURMA

THERE are three distinct types of agriculture in Burma. They are: (1) Hill agriculture, (2) Dry Zone agriculture, (3) Delta agriculture. Of these, the Dry Zone agriculture has had special significance for Burmese people, establishing their traditional way of living and conditioning their integration as a nation. The delta agriculture has most interest for the outside world since it produces that surplus of rice which goes into the export trade. The hill agriculture is restricted both in the number of people concerned with its direction and its external interest.

DRY ZONE AGRICULTURE

At first glance it appears anomalous that the nursery of Burmese people since about the ninth century should be the Dry Zone where the landscape has the features of aridity for most of the year and where, as soon as population density approached optimum for the environment, at the beginning of last century, the Burmese suffered from the agricultural risks attendant on unreliable rainfalls (Fig. 61). The explanation for development in the Dry Zone rather than in what have become the more productive ricelands of the southern deltas, is a complex of environmental and traditional influences, and not one of conscious choice of the Dry Zone in preference to the deltas. Burmese people came to this region from the north, from the landward rather than from the seaward side, and they brought agricultural conceptions from dry rather than from wet environments. In these circumstances, the Dry Zone was within their technological range; they could cope with the conditions of cultivation there and probably find them considerably easier than farther north. This Zone of undulating plains and irregular rivers, low hills and very varied light soils has proved capable of a very mixed agriculture and is still essentially a mixed farming area. Quite clearly too, the Dry Zone, sited midway along the Irrawaddy Basin and at an area of convergence of people moving along the Chindwin, Upper Irrawaddy, Lower Irrawaddy and

Sittang valleys, was one of centripetal influence which at once conserved and strengthened Burmese traditions, enabling them to retain a firm hold against later intruders who followed them from the inhospitable north.

Agriculture in this dry area is at once diversified and broken into relatively small units of property. Paddy grows only in scattered areas, to take advantage of water in narrow valleys, and where some local catchment basin may be used to supplement the rainfall. Small-scale irrigation systems of distributary type (as opposed to storage type) have been developed since the eleventh century, particularly in Kyaukse, and as a whole the Zone became practically self-sufficient in paddy. Irrigation from tanks (natural run-off water impounded inside shallow bunds) is quite common, the small streams of the Zone being too incised, violent and erratic in flood to be controllable or stored by smallholder techniques. The degree of self-sufficiency grew less as the pressure of population increased, but the principle of self-sufficiency continues to be strong in the farming tradition. About two million acres (2.2 million in 1948) are normally under paddy and a portion of this is planted in April-May for harvesting in June-July, a rhythm different from that of most of Burma.

Upon the Black Cotton Soils of this region, cotton has been placed on about half a million acres, mostly in very small units. It remains a crop of peasant farmers and the possibility of extension or elaboration of cotton growing is impeded by the difficulty of obtaining harvesting labour. Cotton is sown in May for harvesting usually in late September, which is generally the end of the local paddy harvest. Often it is intersown with lines of pigeon peas (*pesinngon*) which ripen after the cotton and form a dietetic staple in this country of vegetarian people. The foci of cotton cultivation are Myinyan, Thayetmyo, Meiktila and Pakokku, but the fibre everywhere has low grade. At one time exclusively despatched overland to Yunnan by way of Bhamo, more recently it went to Japan, only 5 per cent being retained for local weaving before 1941.

Since the Zone has low rainfall and light alluvial soils, dry, deep-rooted crops like groundnuts and sessamum are an important part of the Burmese farming system, occupying two-thirds and one and a half million acres respectively, though again broken into very small lots. These oil seeds supply the staple cooking oil of nearly all Burma in normal times. Sessamum, the most important

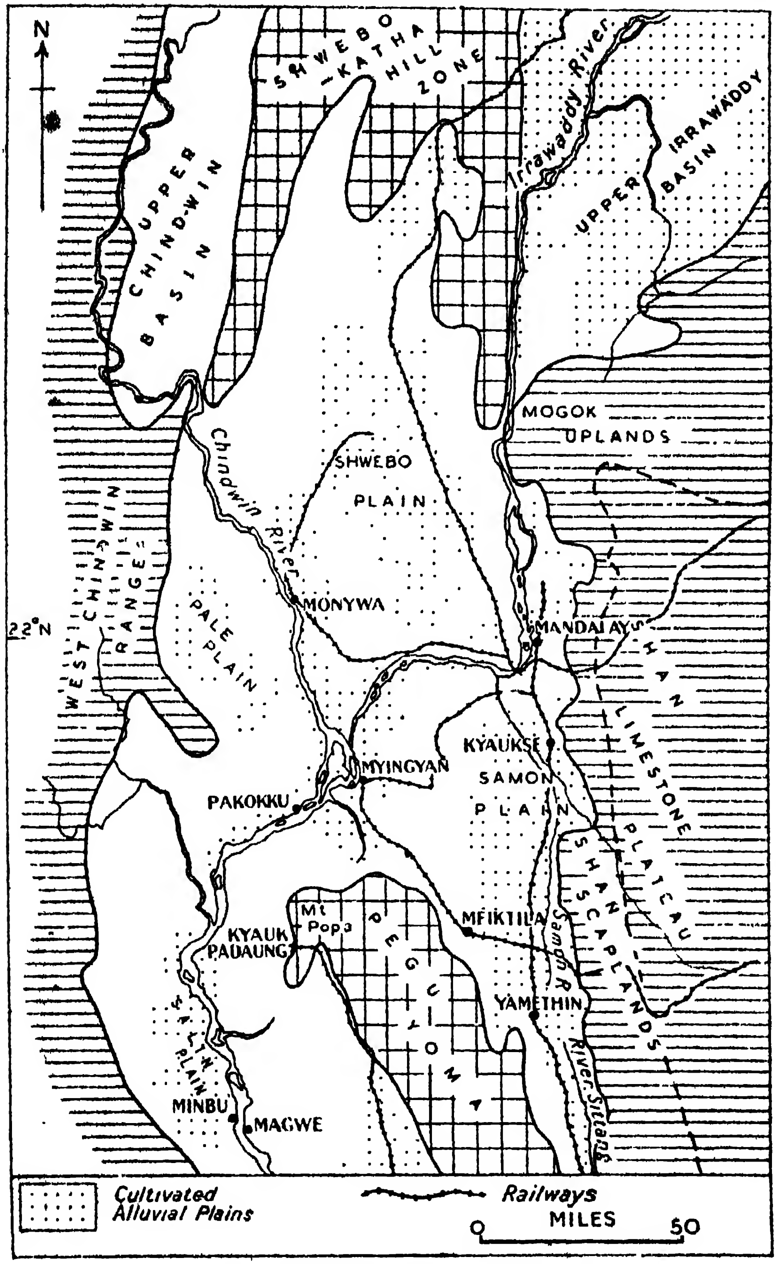

FIG. 56.—The Dry Zone of Burma

of the oil seeds, goes into the ground in June for reaping in early September. In addition, there are ranges of beans, grams, pulses and chillies, all with an important place in local foodstuffs. No less than three and sometimes as much as five million acres of the Dry Zone are planted with millet, which at once reflects the aridity and the lightness of some of its soils. Reliable as a crop even in specially dry years when unirrigated paddy fails, millet goes into local diet to varying extents and has the advantage of being sown later than paddy for harvesting in November, which means farmers who find their paddy failing can cover their loss quickly by planting millet; this accounts for the great fluctuation of millet acreages from year to year, since for most farmers millet is an insurance rather than a staple.

Dry Zone diversified farming would be impossible without bullocks and buffaloes as draught animals. They are bred and reared there on a scale large enough to permit sale to other parts of Burma where climatic conditions are less suited to cattle, which must therefore be constantly replaced from the Dry Zone. This activity (see also the relation between Korat cattle and Lower Siam) is not highly organised yet it is essential in the agricultural ecology of all Central and Southern Burma. It has little significant influence on local diet either in the Dry Zone or in the delta owing to Buddhist and Hindu prejudices. Loss of cattle consumed by armies for food and transport has proved a most difficult problem in rehabilitating Burmese agriculture after 1945.

Thus the diversified agriculture of the Dry Zone is in the first place largely subsistence farming, providing most of what is needed for domestic use locally, and the farmers, small landholders, depending on their families and neighbours for help, have an assured livelihood, buffered against most vagaries of external prices. They invariably own their land-holding, which averages between 5 and 15 acres per family; a holding of 80 acres ranks as a large one. Roughly one-third of each holding in any one year is left fallow and a method of tilth ploughing (*t'ayee t'undc*) is used, which resembles the water-conserving device of dry farming in such settings as Spain. Rotation of crops is regularly practised.

Farming for money is, however, also carried on as a subsidiary activity. Oilseeds, cotton, cattle and pulses are the money producers, mostly going into commerce within Burma, though not exclusively within the Dry Zone. Despite the erratic rainfall, there-

fore, Burmese farmers of the Dry Zone have an agriculture more constant in its effects than at first appears because, being diversified, it is rare that all crops fail in any one year. In any case, double cropping is sufficiently common to act as a further crop assurance. Because so strong an influence of subsistence farming may be traced in the Dry Zone, it follows that, though buffered from the effects of crop failures or abnormally low prices in the external world markets, the Dry Zone Burmese are also buffered from the occasional boom. There is never much money about in Dry Burma and, to that extent, its standard of living is normally lower and the way of living less elaborate than that elsewhere in Burma. Life there in the arid tropics is simple yet exacting, with a pace entirely set by natural conditions and therefore seemingly slow. The peasants live in nucleated, fenced villages and not upon their farmland.

Most settlements have domestic industries based on handweaving of cotton and silk from fibres that are generally imported; over 200,000 handlooms, generally one loom per family, were reported, even in post-war years, to be scattered through Central Burma.

Some exclusively commercial activities go on: the milling of rice and oilseeds, the transport of teak through the zone on the main rivers, the working of the Chauk-Yenangyaung oil wells. These work more on the basis of immigrant labour than of local farmers, and, whatever their rank in export trade, they are little significant in local life, except that in the post-war period they absorb more Burmese workers.

Thus Dry Burma forms an admirable example of a mature and highly developed indigenous agriculture producing enough margin of food and allowing enough personal time to encourage a ripe and imaginative culture expressed in wood and stone carvings and paintings, centring on Buddhist ceremonials, a complex tradition of music, dancing and drama, and a highly decorative dress of the skirt and jacket type which relates to similar modes through Southeast Asia. All of this fits into a balanced ecology which continues to be almost on a subsistence basis, showing considerable caution towards farming for money and interchange with the rest of Burma.

Delta Agriculture

This broad type includes the form of agriculture carried on along the Arakan and Tenasserim coasts and upon the deltas of the

Irrawaddy, Sittang and Salween. The whole character is set by the Irrawaddy Delta where the bulk of agricultural land outside the Dry Zone is located.

The Irrawaddy Delta Agriculture is based on the cultivation of a single crop—rice—on a large and extensive scale with the object of selling the bulk of it. It is monocultivation of the staple Asiatic cereal. Farmers depend on sales of rice to purchase their other basic food needs and only a few fruit trees and vegetables are grown on delta farms to supplement the rice. This monoculture of rice has evolved under circumstances of special geographical interest because, as a result, the Irrawaddy Delta (followed historically by agricultural developments on the Menam Chao Praya and Mekong deltas) has had the same significance for the world's rice-eating peoples as the Argentine, North American and Australian wheatlands have for bread-eaters. Over half the total rice in international trade for the decade 1930-40 originated on the deltas of Burma where some ten million acres of quondam swamp were planted with rice, which occupied the whole agricultural landscape.

This specialised agriculture on a money basis is so new that Lower Burma must be thought of in the same terms as the pioneer agricultural areas of other continents. At the beginning of last century, although rice was the staple food of Burma, it was farmed entirely on a subsistence basis, almost exclusively in the Dry Zone, and the export of rice from there was in fact forbidden by Burmese kings, so that the scanty surplus of Lower Burma at that time went inland to supplement the already inadequate production of the Dry Zone. A little rice trickled from Arakan into Assam, then a province of Burma, but to all intents and purposes, Burma was merely self-supporting in rice and the great deltas were negative areas, undeveloped and covered with forms of swamp forest. Such terrain throughout Southeast Asia continues to be repellent, but the only large-scale examples of still untouched deltaic swamp may be found along the east coast of Sumatra where may be seen something of the conditions prevailing on the Irrawaddy and other Burmese deltas only 150 years ago.

Penetration of the deltaic zone began just before the middle of the 19th century, but reliable statistics are available only since 1870. The following figures sum up the development of Burmese ricelands:

Year	*Acres of Burma under rice (millions)*	*Lower Burma only*
1866	1.75	1.44 (1865)
1886	4.00	3.70 (1885)
1896	5.75	5.00 (1895)
1910	9.95	7.81
1920	10.30	8.59
1930	12.37	9.91
1940	12.80	9.95
1950	9.30	6.70

These figures of expanding acreage under rice are the more astonishing because the expansion implied the clearing, flattening, draining and organising of freshwater swamp terrain, processes carried out exclusively by manual methods without any mechanical devices or elaborate equipment. The vast acreage of riceland in the Deltaic Zone now is a monument to the sustained effort of millions of peasants working only with bullocks or buffaloes and the simple, locally-made ploughs and implements they had evolved in their own way over the centuries. Too little attention has been given to this aspect of large-scale pioneering squatters in the virgin swamps of Lower Burma, an amazing development at roughly the same time as the pioneering on the world's wheatlands and well in advance of similar developments in the deltas of the Menam Chao Praya and Mekong which were imitative of the success achieved in Burma. The rates of annual increase of rice acreage rose to a peak during the last twenty years of the 19th century.

RATE OF EXPANSION OF RICE ACREAGE IN LOWER BURMA

Period	*Acreage: Average annual increase in acres*
1852–72	63,577
1873–82	117,490
1883–92	164,041
1893–1902	162,595
1903–12	136,888
1913–22	78,867
1923–32	84,105
1933–37	14,385

Paralleling this agricultural expansion on the deltas, people migrated southwards because the development in the first instance was essentially by the hands of Burmese peasants who took up

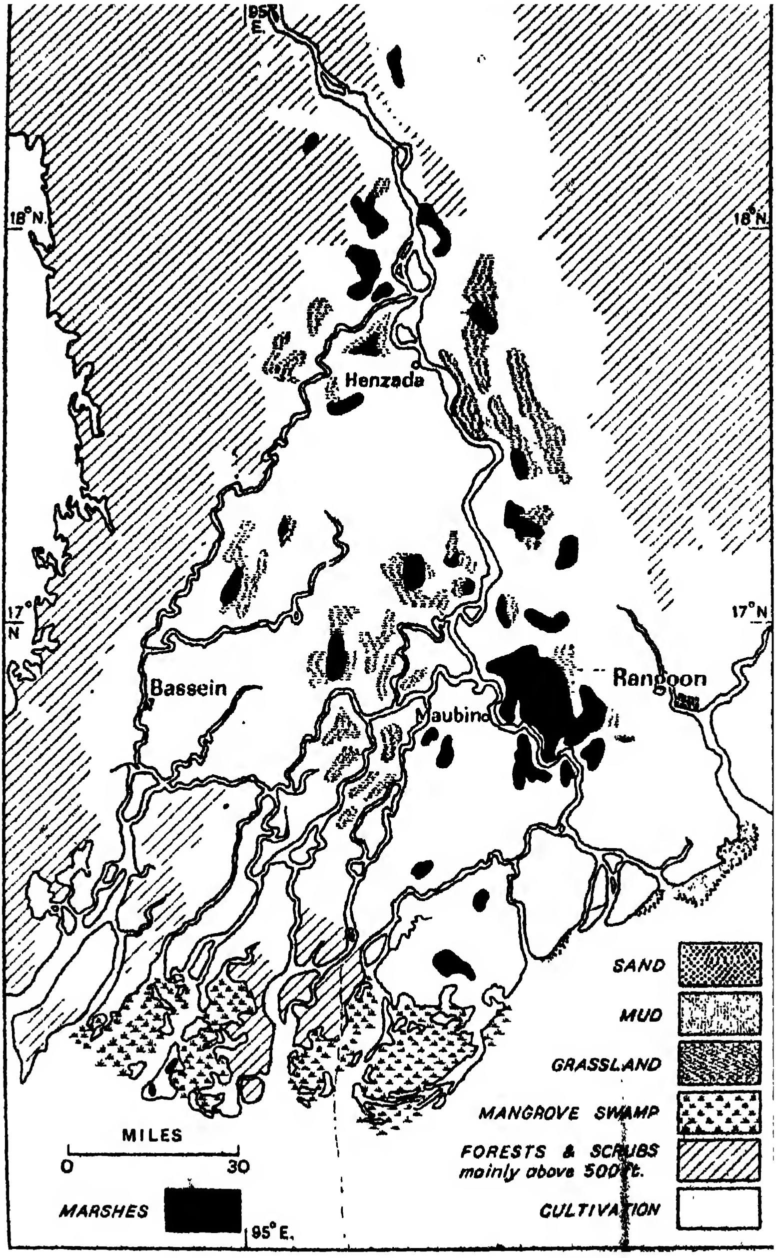

FIG. 57.—Land Use in the Irrawaddy Delta

paddyland on the delta. The high rate of increase of Burmese paddy-lands at certain phases of the '80's might justify calling it a scramble for pioneer lands—a "rice rush" to use an expression more common for gold and tin rushes. The main rush to the Delta had taken place before census figures became available and after 1880 an evening up throughout Burma was already apparent. The first rice rush seems not to have drained population significantly from other parts of Burma so much as to have formed an outlet for the population which here, as over all parts of Southeast Asia, was rapidly expanding.

POPULATION CHANGES IN BURMA

Year	*Lower Burma*			*All Burma*	
	Millions of persons	*Percentage of 1881*	*Percentage of all Burma*	*Millions of persons*	*Percentage of 1881*
1872	2.59	—	—	—	—
1881	3.57	100	61	5.9	100
1891	4.41	122	57	7.72	131
1901	5.41	150	51	10.49	178
1911	6.21	173	51	12.1	205
1921	6.86	191	52	13.2	224
1931	7.77	215	53	14.7	249
1941	8.92	249	53	16.8	284

Gradually, however, the labour question arose, as it has done in every pioneer territory; the land under rice increased beyond the capacity of the traditional Burmese family and communal systems to deal with. It was difficult enough to get the new lands cleared for rice-farming and as crops came along, the situation was worse because every rice seedling is plucked separately by hand and every ripened head is cut by sickle. That the crop was for cash sales led inevitably to hired labour, mainly from India, and it was not long in the Burmese community, traditionally not organised on a cash basis, before the rate of spending, whether on non-essentials, on labour or on mere subsistence during poor years, as in the depressions of the 19th century, exceeded the average income, leading in turn to loans of money from outsiders, to mortgages and very soon, instead of a pioneering community owning and working its land, it became a money agriculture on farms in the hands of mortgagees. Thence it became an estate agriculture renting to tenants or employing labour at wages, and

the wage earners included the original peasant farmer, now landless and no longer assured of getting his staple rice for his family consumption, and also the landless group which originally farmed as labour hired by the peasant farmer. By 1936 over 9 million acres of Lower Burma agricultural land had transferred from

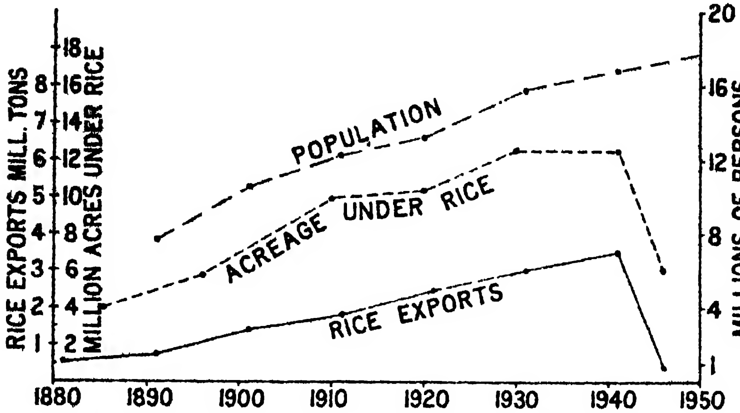

FIG. 58.—Burma : Changes of Population and Agriculture

peasant owners to mortgagors and landowners who thereafter rented it back to the peasants.

This delta agriculture has ultimately led to the disintegration of the original Burmese system of cultivation based on personal landholding and family or communal co-operation, which is now confined to Dry Zone farmers who continue on their smallholdings as subsistence farmers, only lightly touched by the system of farming for cash. But the paddylands of the Delta are still the chief source of Burma's commercial rice, and the rental system developed there at any rate assures a steady flow of rice into trade, because the farmer must immediately after his harvest get cash to provide the rent, which is a fixed money payment on a short lease of two or three years. Thus agricultural land became a social problem in Lower Burma, as within a century it changed from the system of pioneer landowning peasant to one of short-term tenants who found themselves in a more prejudiced and unfavourable position than has arisen in the very oldest land systems of Europe, where at any rate *latifundia* are broken down into farms rented on a percentage of crop basis (as opposed to a fixed

cash rental) which buffers the tenant from some of the worst evils of external price changes for the commodity he produces.

The Second World War had a great impact on the weak agricultural structure of Lower Burma where the abandoning of three million acres of paddy over the period 1941-48 almost entirely accounted for the national decline of paddy acreage.

As a result both of the opening up of the new paddylands of the delta and of the progressive squeeze to sell rice brought about by the changing social systems, Burma's outflow of rice into commerce has expanded enormously, at a rate considerably faster, until the present decade, than the population increase (Fig. 58). The following figures make a picture of rapid expansion of Burmese agricultural production which has grown faster than that of the pioneer wheat producing areas (the U.S. and Australia), accompanied though these were by greater proportional population increases and rapid mechanisation of field work:

Year	*Burma's Rice Exports (million tons cleaned)*
1881	.52
1891	.82
1901	1.42
1911	1.78
1921	2.45
1931	3.00
1941	3.50
1946	.43
1950	1.20

These exports represent surpluses over internal consumption which in 1941 roughly equalled the amount exported.

The bulk of the deltaic paddy crop comes from "rainfall" swamps, which receive the necessary floodwater direct from the heavy rains of Lower Burma rather than from systems of irrigation drawing water from the Irrawaddy itself (Fig. 59). There are bunds (*kazims*) round every paddyfield and systems of channels to drain away the surplus in due course, and relatively little is fed to the fields from the Irrawaddy in spate. This is a peculiar interaction of physical conditions in the Delta, where local rains produce floods well in advance of the peak heights of the rivers, which behind their levee-like banks often run at higher levels than the rain-flooded fields on either side of them. Farmers of the Irrawaddy Delta thus have the problem of protecting their paddyfields from flood by the river, not the more usual one of using the river

floods to irrigate the paddyfields. Because the Irrawaddy comes to the sea in a rainy area and not a dry area, the control problem resembles that of the Lower Rhine rather than that of the Nile. Only on the right bank of the Irrawaddy have major embankments been built to protect fields that side. The technique of using local

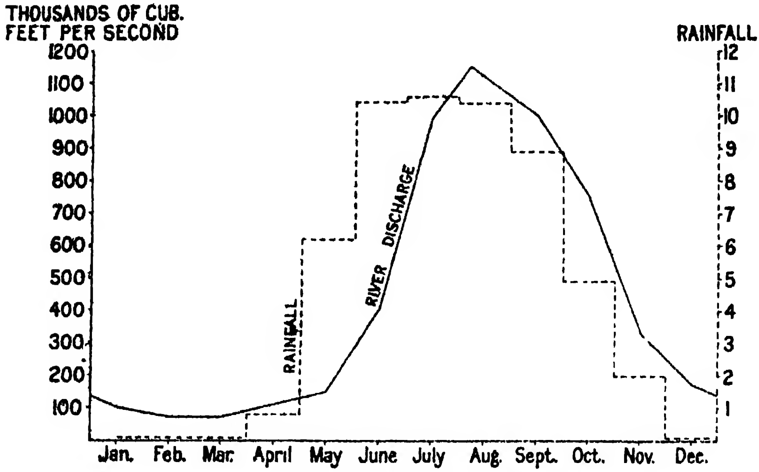

FIG. 59.—Régimes of the Irrawaddy Delta

rainstorm floodwater (and to some extent the spates in small streams originating within the delta area) implies that the Irrawaddy load goes almost exclusively into the sea and does not contribute much to building up the delta surface.

The process of rice cultivation in Burma is the one common to most of Southeast Asia. To work the ground, the local plough is simple, consisting of little more than a light wooden tooth or sole tipped with iron and intended to break the ground, not to turn it in the European manner. In addition, farmers make very extensive use of a form of harrow upon which they depend for levelling the fields, puddling the wet surface at planting time and clearing the weeds. All delta rice is transplanted, usually with many female helpers, from a nursery or seedbed, usually one-tenth the area to be farmed. Transplanting has only so far been possible by hand, so that it makes a high demand on labour over the short planting period. Upon the seedbed, animal manure from the farm cattle is usually spread, but the other fields are not manured. Very little land is left fallow and no rotation has been

devised, so that symptoms of over-cultivation have quickly appeared, hastened by the dependence on rain floods rather than on silt-laden river floods. Only in Akyab has broadcast sowing become the tradition, where it yields somewhat less than the transplanting system. This is less a mere convention and more the result of the character of local rains, because there must be careful correlation between the rising flood in the fields and the height of the growing rice plant which needs just to show above the water surface without either being submerged or drying out.

Between planting and harvesting, little attention needs to be given to the growing rice. High winds in the late-growing period or cyclonic storms during the ripening period may cause crop damage and call for palliative field work. It seems incredible that all Burmese paddy is cut by hand, using only the sickle; it is traditionally a male activity, which explains the great need for male labour at harvest time, the labour peak of the Burmese farming year. Threshing is still done upon sunbaked mud floors where the paddy sheaves are stacked and then trampled by the buffaloes or oxen until the grain is loosened. Afterwards hand and wind winnowing separate the grain from the chaff with the help of a rough bamboo tripod from which the threshed mixture is slowly poured so that the grain falls below and the chaff is blown to the side. After this stage, the grain is sacked and goes into the circuit of transport and brokers to the rice mills. For seed and local use, about 17 per cent of the Lower Burma crop remains on the farm.

At least 95 per cent of Burmese lowland rice may be called a winter crop. The rhythm of planting activity reaches its peak in July and that of harvesting in November and December, a period of much more concentrated activity than at planting time. From mid-December to mid-January the bulk of the crop is moving towards the mills, firstly by cart towards local collection points, then by water to the milling centres. Burma's elaborate river system is an essential part of its rice commerce because upon these rivers, in small country boats and barges or—on main streams—in river steamers, most of the rice moves. Little cutters travelling coastwise bring the rice to the major centres from patches of riceland up and down the coast. Without this water transport, we may doubt whether commercial rice production would have been possible at all, because trade in rice has for a century been possible only by maintaining very low prices.

Rice milling ranks as a separate industry. It has steadily changed character, having been for most of last century a Europeanised industry near the ports, but in the present century dozens of small capacity mills owned by local people have been set up along the main rivers at the foci of paddy-growing areas, where the gaunt structures of corrugated iron mills make an unusual note on a landscape otherwise still dominated by traditional Burmese forms. By 1941 about 700 mills were in operation; of these 650 were small, dealing with less than 100 tons of rice a day, and the larger ones were in Rangoon, Akyab, Bassein and among the distributaries south of Henzada.

Until the milling operation removes the outer skin, the cereal is frequently called by terms differing from those used for the grain after milling. The actual words vary from country to country. In the rice trade, which is no less complex in its nomenclature than the wheat trade, there is the grading of broken or unbroken rice, the broken being grain fractured by milling. Technical terms distinguish grain containing various proportions of broken rice, the more broken being *pari passu*, the cheaper. Another process is that of polishing, a milling process giving a shine to the grain. Increasingly popular among Asiatic people, particularly in India, is parboiled rice—grain which undergoes steaming, boiling and drying processes, said to give it a better vitamin content and keeping quality, the latter being specially attractive to labourers wishing to make one cooking of rice which will last through the whole day.

Those Burmese farmers who retain some rice for their consumption during the year use hand-milling methods involving both pounding and milling, but they have increasingly sold all unhusked paddy except that needed for seed, and purchase milled rice for their domestic use.

Although the harvesting is almost completed in the two months, November-December, milling is fairly evenly distributed through the year, at the rate of about a quarter million tons monthly, the spread arising from varying distances and brokerage considerations in a territory where transport is simple and slow.

Rice was ranking just before the war as 40 per cent of Burma's export values, but its significance was much greater than this, because the bulk induced a high shipping tonnage between Burma and its rice markets. About 70 per cent of the rice moved out

through Rangoon. The ports of other rice-growing areas, Bassein (12 per cent), Akyab (9 per cent), Moulmein (6 per cent), handled a relatively small volume of the rice exports which derived overwhelmingly from the Irrawaddy Delta, and less from the hinterland of these subsidiary ports. At Rangoon, Akyab and Moulmein shipping of rice was exclusively in sacks and by way of lighters, which loaded steamers at Rangoon with the output of mills situated in minor inlets and creeks, away from Rangoon proper and not accessible to deep draught shipping.

The rhythm of export was distinctive. Each of the months October, November and December exported about 5 per cent of the year's total, and the monthly outgoing thereafter increased to a peak in March when nearly 15 per cent of the year's export left Burma. Then the rate of export diminished again. The hurried post-harvest export was explicable by the absence of large storage space at the ports and the rapid deterioration of any rice stored through the wet season.

While the direction taken by Burmese rice exports changed in detail according to the state of the rice harvest in surrounding countries, about half usually went to India, 12 per cent to Ceylon, and 6 per cent to Malayan ports. Long distance rice trade was never large, yet it had special significance because it absorbed the highest grades; Burma has always been the chief long-distance exporter, serving Holland, the United Kingdom, Germany and China.

Hill Agriculture

In the Burmese hill districts may be seen examples of cultivation types at various stages of evolution from "shifting cultivation" called *taungya* (literally "hill-field") in Burma, to sedentary cultivation.

The whole hill zone outside teak reservations is peopled by groups whose basic and traditional form of farming is *taungya*. Their experience with the more amenable valleys leading into the Irrawaddy Basin has encouraged the fixation of agriculture, particularly in the Shan Highlands, yet shifting agriculture still goes on and probably at least 7 million acres t any one time are temporarily occupied by people who set up their villages near a clearing and move their villages every four or five years as they shift their interest to a new clearing. Formerly shifting cultivation

went on even in the Irrawaddy Delta and it continues to be customary in the contrasting types of level open country round Myitkyina and Mergui. As late as 1930 cotton was an important *taungya* crop at Thayetmyo. Migrant farming partly accounts for the mobility of the clans and tribes who have been constantly moving over the Burmese hills for centuries (Fig. 62). The forms of farming evolved in this tropical jungle, from the hunting-collecting type to the shifting agriculture and so to the fixed agriculture in the valleys, make an interesting contrast with parallel conditions in tropical Africa where the evolution largely turns upon variants of animal farming; apart from pigs and chickens, animals have no great place in Burmese hill agriculture, which centres upon subsistence crops of dry rice, millet, yams and sugar.

Though simple in its scheme, hill farming is not easy. With the limited labour and simple tools at its disposal, a family finds the clearing of new fields from virgin forest represents most of a whole year's work. These hill farmers are far more mutually dependent than fixed farmers of the plains and their clan or tribal structures are the tighter, making their style of farming, their general culture and tradition remarkably uniform over wide areas, irrespective of language or origin.

The physical problem of erosion caused by extensive shifting cultivation has not been fully studied in Burma. Probably 14 million acres lie bare to the torrential rains at any one time, allowing for existing cultivated areas and those recently abandoned. In addition, the hill peoples have been steadily increasing in numbers over the last 150 years at least, and the rapid silting of the Lower Sittang in recent years may quite well reflect greater erosion arising from more intensified cutting of the hill cover by the increasing hill population. At present about 2½ million people in Burma are estimated to be engaged in *taungya*, an activity more elaborate and widespread in this continental sector than elsewhere in Southeast Asia. The Shan Highlands have in part a fixed agriculture, often including plants of temperate latitude, concerned with market gardening and fruit farming for Rangoon. *Tung* trees have proved a successful cash crop introduced from the Chinese side of the border; the oil extracted makes a high quality varnish. Tea is grown by Shans for the Burmese market only. Farther south, in Tenasserim, the rubber and coconut

plantation techniques of Malaya have been introduced this century on a small scale.

The overall picture of agricultural activity in Burma provides interesting correlations with Malaya. In both countries there has been a rapid change-over from subsistence farming to cash farming. In Burma the key item of cash farming is the local staple food, rice, while in Malaya it is the non-indigenous, locally-unusable rubber. Both zones have been pioneering areas, the one on the basis of immigrants, the other originally on the basis of indigenous Burmese peasants. The whole structure of trade and commerce for both countries has been built up on a large-scale production of single commodities, rice and rubber, whose value depends on external assessments.

Chapter Eleven

THE SOCIAL GEOGRAPHY OF BURMA

THROUGHOUT Upper Burma, the history of tribal clashes has left a tradition of tightly nucleated settlements enclosed by a stockade situated in valleys near enough to the fields yet well out of the *chaungs* or torrential water courses. Bamboo, timber and palms are the universal structural materials and they provide domestic utensils produced by a wide range of cottage industries.

Upon the Irrawaddy Delta, the pioneer tradition, foreign influences and the long period of social security, have led to loose settlements designed to take advantage of slight embankments across the swamps, and houses are strung along levees beside the distributaries and along old spits paralleling the seaward edge of the deltas. For urban settlements, brick and imported corrugated iron are the structural materials. In the Delta landscape, the greater security and the linear village form combine to eliminate the conventional stockades, and the cash economy is made apparent in the frequent show of foreign textiles and domestic utensils among the peasants.

POPULATION PATTERN

Essentially an agricultural people, the Burmese concentrate on the best agricultural lands (Fig. 60). Even so, Burma has the lowest nutritional density (population per cultivated acre) (Fig. 61) of any Southeast Asia territory, rivalled in this only by Malaya. Greatest population density lies roughly within the triangle Henzada, Bassein, Rangoon, in the upper and older part of the Delta where average densities are 250-500 per square mile. The rest of the Delta and most of the Irrawaddy Basin up to Thabeikyin have densities averaging 125-250 per square mile, which occur also in the narrow sedimented zone round Akyab. Outside these areas, in the far north and in the Shan Highlands, population thins out until in the Western Ranges there are less than 25 persons per square mile.

The pools of peoples to the north and in Central Asia have

combined with the basin topography of the terrain to produce a steady compression of many peoples at differing stages of development into the relatively dead-end location of Burma (Fig. 62). Of these people, the Burmese have established greatest coherence and set the ethnic character of the whole Irrawaddy Basin, which is almost exclusively occupied by them as far as the latitude of Bhamo; they constitute two-thirds of the whole population (16.8 millions in 1941). Towards the south they have inter-bred with Mon Khmer groups (known as Talaings in Burma) who, part of those highly developed Indo-Malayan peoples found also in Siam, Indochina and Malaya, preceded the Burmese in the Irrawaddy Basin.

The national nucleus of modern Burmese is the Dry Zone whence they have in more recent historic times pressed out southwards. Their physique, culture and character is Mongoloid with cultural assimilations from the Mons. Their speech is tonal and monosyllabic, related to Tibetan but with script and grammar derived from Pali through the Buddhist priesthood, the literary tradition of which has made 50 per cent of Burmese males literate—a higher vernacular literacy rate than anywhere else in Southeast Asia. Burma has sometimes Burmanised other and later waves of peoples from the north, sometimes diverted them, as in the case of the Shans who migrated southward later and were forced into the eastern highlands and Siam, while another Mongoloid group, the Karens, was pressed in turn to the southern highlands and to the Pegu Yoma. Today the distinction between these rival groups persists and 9 per cent of the people of Burma describe themselves as Shans and 7 per cent as Karens. Isolation, differences in language, and transport difficulties have perpetuated differences which appear sharper than the similarity of social and cultural habits justifies.

In the more thinly populated areas of the western and northern hills, ethnic fragmentation has proceeded farther. These hills have been called an ethnological maze of tribes stratified by altitude and by inter-digitations along valleys. Burmese call all tribes of the Western Mountains Chins, though among the tribes at least 60 different languages are in use and the tribal names are equally varied. While they have played little part in the modern evolution of Burma, a number of not too difficult ways cross these hills from Assam; of them, the Myittha route through Manipur, the

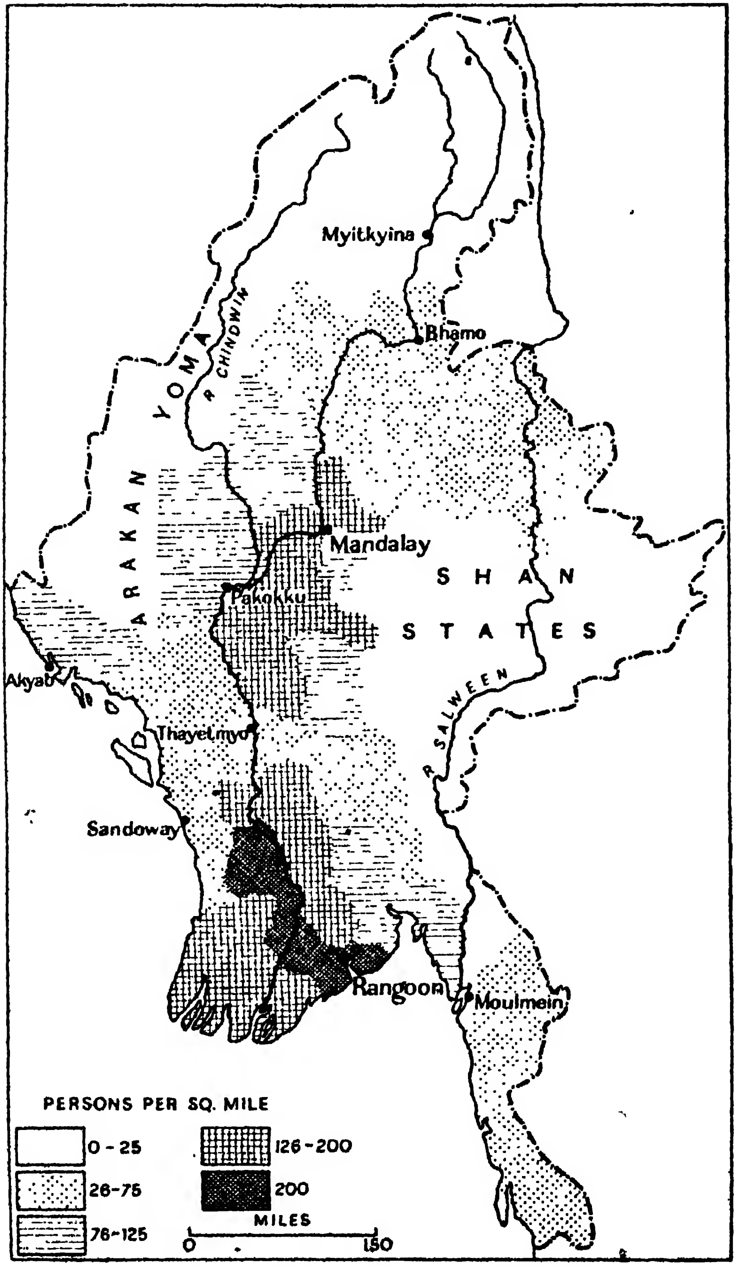

Fig. 60.—Density of Population in Burma

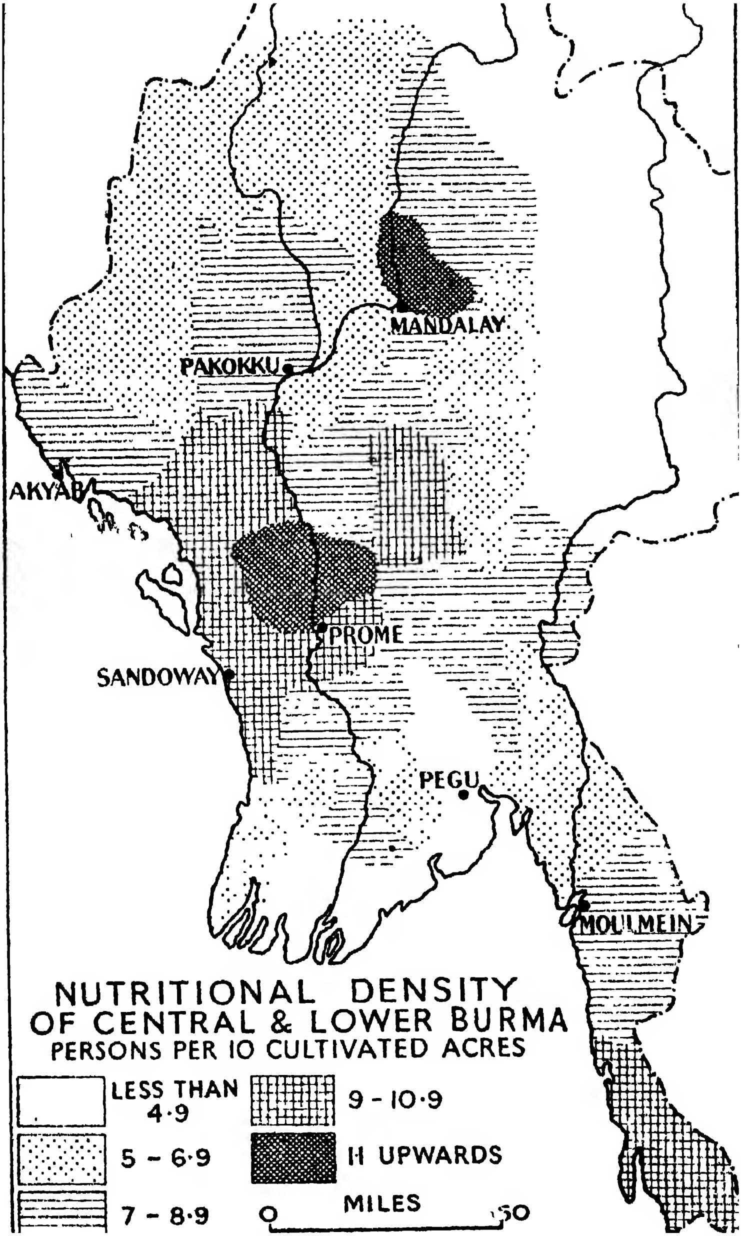

FIG. 61.—The Relation between Cultivation and Population in Burma

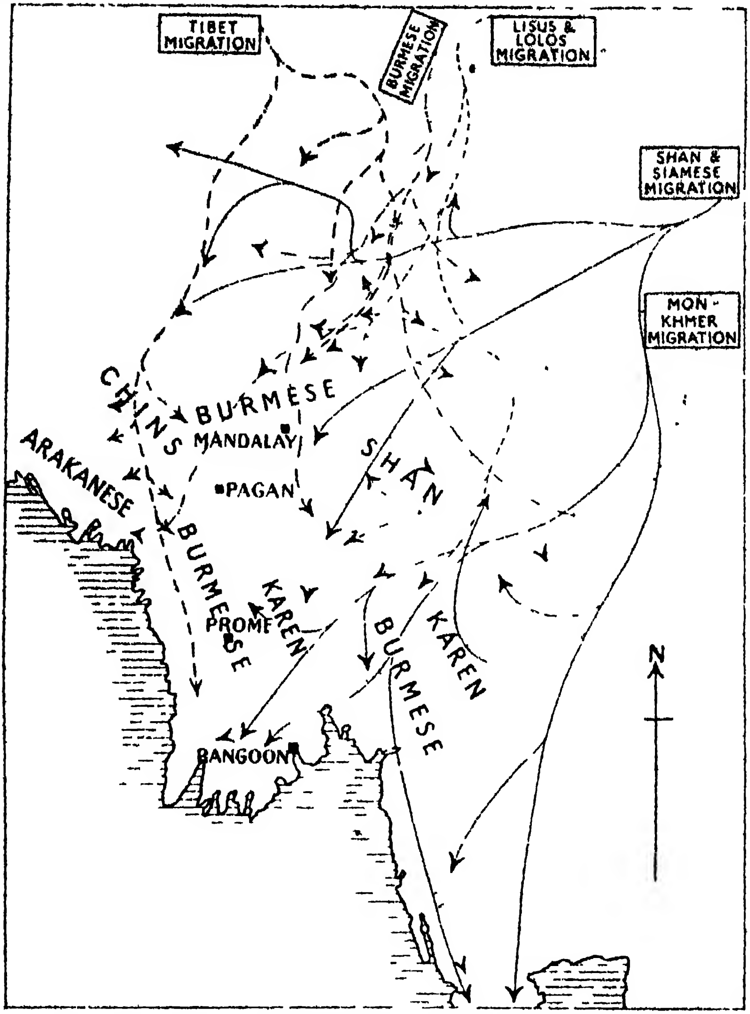

FIG. 62.—Burma : Overland Migrations and Communal Patterns

An route from Arakan to the Dry Zone and the Taungup route to Prome were used in historic times, though travel through these tropical valleys is by no means easy and overland movement is better facilitated on the drier uplands. From the north, the Hukawng Valley and the Tuzu Gap have been lines along which known groups have entered. From Assam and the north by these routes came peoples of a Mongoloid or Tibetan type resembling those

already in Burma. A contemporary parallel to the historic migrations from the north has become evident by the repeated pressure of Chinese people from Yunnan into northeast Burma and the Shan States, where at times the Chinese have ranked as a political problem.

Though Buddhism has become the characteristic expression of Burmese cultural life, its entry into Burma was neither caused by, nor cause of, subjugation to India. Into the Arakan deltaic zone have steadily filtered peoples from India over the past two millennia, followed by interbreeding with indigenes so that the Arakanese people differ slightly from the main Burmese stock with which, however, it was constantly in contact through the Arakan Yoma.

Large-scale Indian contacts are relatively modern features of Burma and came in two distinct stages. Firstly in mediaeval times the trade and interchange between India and China skirted Burma to the north by way of Tibet over the mountain routes, and, more significantly, southward round the coast, where points of call for shipping grew up from Akyab to Pegu, Moulmein and Mergui as successive laps on that trade route partly seaborne, partly overland, which crossed the Kra Isthmus. Buddhism came to the Burmese along this sea-route, followed in its time by Islam which has established little more than a minor cultural influence in the Akyab area only. This formed part of a trade movement skirting the nucleus of Burmese people, whose agriculture and state organisation was inland, in the Dry Zone. At that stage the skirting trade influenced the Burmese very slightly and their traditions developed in their own way and at their own pace within the protective isolation of the interior.

Yet it was along the coast that the momentum of activity gradually increased, to create influences centrifugal to Burma and out of harmony with the centripetal influences of the Dry Zone. Following the coastwise trade route came the East India Company, through which the British became associated with Lower Burma. As a result of the administration of the East India Company from Calcutta, the centrifugal influences round Burma drew that fringing zone within the commercial and organisational orbit of India, and, although the control from India ceased by formal governmental separation in 1935, commercial ties with Calcutta continued and governmental forms and traditions in Burma had

already received the indelible impression of the Indian pattern whether or not it suited the Burmese environment.

Then came the migration of Burmese as pioneers to the new delta paddylands which were brought under control in Akyab, the Irrawaddy Delta, the Lower Sittang and, to a less extent, Tenasserim. The new cash agricultural system developed in these pioneer areas led to a heavy demand for labour, far more labour than Burma could supply—and it was met by seasonal migration from the congested areas of Bengal and Madras. Over recent decades the flow has decreased so that the movement of Indians to Burma in 1937 was half that of 1927 and stopped in 1942 when over half a million Indians are thought to have returned to India.

The movement both ways was governed by general economic conditions in Burma relative to those of India; in 1928, for example, there was a net immigration of 85,000 Indians, declining to a net emigration from Burma of 57,000 in the 1931 depression. It is to be stressed that the peak period of developing new paddylands, 1880-1900, was not the peak period of Indian immigration, showing that the rice pioneering was largely by indigenous Burmese peasants in the first place.

Thus the commercialisation of Lower Burma has led to the introduction of foreign populations, just as has been the case in Malaya. These Madrasis and Bengalis came originally as seasonal migrants, making for the Irrawaddy Delta in the harvesting season and returning to India immediately afterwards, or in the next dry season, having done a series of jobs from harvesting, reaping, and milling to repairing the field bundings. To this extent the duration of one man's stay was on the average shorter than was the case with non-seasonal migration into Malaya. Gradually they came in also for the non-seasonal work of running the railways, the harbours, the river shipping, milling, lumbering and the other industrialised occupations established by the commercialisation of Burma over the last hundred years. Early labour difficulties in these specialised occupations were in part met by official subsidies from the Burma Government to encourage Indian immigration.

Thus a steady settlement of Indians and their families took place and by 1941 over a million Indians were living in Burma, principally in the urban and commercial centres of the coastal and deltaic zones. Hindustani became the second language of the country, and the professions and the administration for a time

were almost exclusively Indian in personnel. In this way the multiplicity of peoples already in Burma was complicated by commercialisation and urbanisation based on Indians.

How the early Burmese pioneers of the newly opened rice areas of the deltas gradually lost their independent smallholdings and became tenant farmers has already been described. To complicate the issue, the hands into which the mortgaged lands fell were Indian, mostly of the Chettyar Indians, who became owners of half the Delta's agricultural lands by 1931. They were foreign, absentee non-agricultural landowners, which added to the Burmese farmers' economic difficulties the passion of racial animosity which had scarcely arisen while the immigration of foreigners was confined to the temporary agricultural labourer type. Thus, the Irrawaddy Delta was not only foreign to Burma in its agricultural system of cash crops; it was more concerned with overseas interests and overseas trade. The port of Rangoon was almost the sole entry and exit of the country; land on the Delta was largely in the hands of foreign Indian owners who encouraged still further cultivation by compatriot Indian labourers. This split Burma into the centripetal zone, the Dry Zone, essentially Burmese and poor, and the centrifugal zone, the wealthy Irrawaddy Delta and Rangoon, essentially foreign and mainly Indian, an exit rather than a nucleus of Burma. While, then, Burma's earlier history was one of a dead-end to Mongoloid migrations, the relative emptiness of the new most fertile part of the country made it a magnet for the impoverished, loose-footed peoples of congested eastern India.

Urban Centres

Only two places, Rangoon and Mandalay, can be called big towns; of the others, only Moulmein, Bassein and Akyab contain over 40,000 people. Towns may be classified as minor ports and estuarial rice centres, such as Akyab, Bassein, Moulmein and Tavoy. In addition there are river ports in a string from Henzada to Bhamo, lining the great Irrawaddy waterway, which is commercially navigable to 900 miles inland. Many small towns like Myingyan have the rural industries of oil pressing and cotton ginning. Yenangyaung and Namtu are garish and makeshift oil and mining towns. The railway and administration centres often have a long history, as is the case with Pegu, Shwebo and Toungoo. All these places have been described by Spate as little more

than overgrown villages, sprawling vaguely round a few buildings often of the "corrugated iron" period; they were pioneering settlements in character, whatever their history.

Rangoon (half a million inhabitants in 1941) stands at a point where converge the Irrawaddy waterways, an overland route to the foothills of the Pegu Yoma and overseas steamship routes. Itself accessible by ocean-going steamers, Rangoon thus commands the approaches to Burma by both the Sittang and Irrawaddy waterways and valleys, as well as along the Pegu Yoma, which is a well-drained land route followed today by the railway. The town has the rectangular pattern common in pioneer towns and it had no local significance until external trade developed over the last century or so. Its prewar aspect was distinctly Indian though Burmanisation of the administration has gone on rapidly since Burmese governments were established there. In its function as chief port, Rangoon has handled over 4-5th of the country's external trade and been the gathering point of great numbers of Indian migrants with a seasonal volume of passenger traffic to and from India, which totalled over half a million annually for the period 1921–31. Overseas shipping and interests gave Rangoon a cosmopolitan air, the most modern and westernised town in the country. Though the port suffered to some extent by being off the general run of major ocean-going steamers, its international significance was increased when it became a halt on transcontinental airlines linking it to India and Europe, Bangkok and the Far East, and to Singapore and Australia. About one-third of a million Chinese had settled in the different ports of Lower Burma as traders, more resident than migrant. For a time the Rangoon-Lashio-Kunming route to wartime China produced a feverish activity among Chinese in Rangoon, but there is little postwar evidence that this route into inner China is likely to assume permanent value. There has arisen no serious movement to change the function of Rangoon as the administrative capital of Burma in its independence (1948). The city suffered more from war in the Far East than any other capital of Southeast Asia except Manila: its transport facilities were destroyed and this, together with the breakdown of internal organisation, paralysed trade which, despite greatly increased prices, was in 1946 valued at only 54 per cent of that in 1940.

Mandalay, historically associated with Burmese kings, is a much

smaller and now war-scarred town which never ceased to be entirely Burmese in its tradition. It had less than 200,000 inhabitants, yet these had created a cultured and matured social atmosphere in the Oriental manner, with an elaborate and indigenous art, music and drama which was paralleled in few other parts of continental Southeast Asia, where pioneering has so far evolved little that is mature.

While the detailed geography of urban Burma will have suffered most from the two military campaigns fought through it in 1942 and 1944, the pattern of the countryside remains the same, with minimum effects on the subsistence farming areas of Central Burma and maximum effects in the commercialised deltaic fringes where not only has trading organisation been destroyed but also much of the migrant labour has ceased. The Indian population has changed considerably because over 600,000 Indians trekked through the Arakan Hills into Assam in 1942, a fact of special significance in the social and commercial structure of post-war Burma.

Regional Geography

Four relatively densely populated regions are the core of Burma's geography (Fig. 49):

1. *The Dry Zone*, whose dry climate, subsistence agriculture and exclusively Burmese tradition make it the most distinctive region, centring on Pagan and Mandalay. Its boundaries are partly the 40″ isohyet, emphasised by sharp marginal relief changes.
2. *The Lower Burma deltas*—where, centring on the Irrawaddy Delta, and spreading through the Sittang Delta, a commercialised agriculture based on rice, foreign trade and foreign labour has created a composite non-Burmese region whose evolution has given Burma a second and powerful focal point, Rangoon.
3. *The Arakan deltaic coast*, a minor paddy-growing area and historic line of Indian approach to Inner Burma, with less population than (1) and (2). Sharply confined to seaboard by "Pacific type" mountain ranges inland, it has tended in the last half century to be related commercially to Bengal rather than to Burma.
4. *The Tenasserim Coast* is a highly varied region of ranges, fringed by small cultivated lowlands hedged in by mangrove swamps

where the setting and the pattern of local life resemble those of Eastern Malaya. Rubber, tin and coconut production give it a commerce distinct from that in the rest of Burma and relate it more to the Kra Isthmus.

All the remaining regions of Burma have hill or mountain landscapes, thinly populated, with agriculture still evolving from migrant cultivation to fixed cultivation and at different stages of Burmanisation going on among the many tribes and clans living there. These regions are:

5. *The Western Forest Belt*, a completely forested region, stratified into types altitudinally and having rain forest on the western flanks and deciduous forest on the seasonally dry eastern flanks, the whole drained by longitudinal and trellis patterned rivers, the chief ones flowing to the Irrawaddy.
6. *The Northern Irrawaddy Basin*, north of the latitude of Bhamo, where the basin merges into the Himalayan mountains, and becomes a series of high N-S. ranges, trenched by headwaters of the Irrawaddy River and leading up by high mountain wastes into Tibet and Inner Yunnan. Through this very thinly populated territory came many of the present Mongoloid tribal groups now in Burma.
7. *A transitional region* of rising altitudes, increasing rainfall and teak forests between the Dry Zone, the Northern Irrawaddy Basin and the Shan Highlands.
8. *The Pegu Yoma*, a thinly peopled inlier region of young warped rocks between the Lower Irrawaddy and the Sittang, with vestigial volcanic cones to the north, oil on its NW. flank and commercial teak nearly everywhere.
9. *The Shan Highlands*, a zone of cool seasons (due to altitude) and more rainfall than the Dry Zone, producing deciduous forest and a subtropical mixed forest, reflected in subtropical agriculture with rice cultivated only in the warmer lowlands. Occupied by Shan peoples who are related to the Siamese, it connects as readily to Siam as to Burma. Commerce has intruded towards Lashio and Kalaw which are rail terminals for the routes into Yunnan, and at Bawdwin where there are lead mines and a growing *tung* plantation industry. This terrain is thought to have considerable prospects for agricultural and population developments. The Salween runs through it without providing a negotiable line of approach.

The nine regional units are linked together simply :

(*a*) By the Irrawaddy waterway, which suits the needs of the middle and lower Irrawaddy basins for cheap and bulk transport; and focuses on Rangoon as terminal and entrepôt.

(*b*) By the Rangoon-Myitkyina railway running first along the Pegu Yoma foothills to join the Irrawaddy at Mandalay, and by the Mandalay-Lashio branch leading to the Yunnan road. Over the period 1926-36 railway traffic (passenger and freight) showed great falling off. There is a fanning of railways from both Mandalay and Rangoon; from Mandalay, lines reach Yeu, from Thazi they reach Myingan and some miles beyond Kalaw, to Heho, from Pyinmina a line crosses the Pegu Range to Kyaukpadaung; in the south there are links from Rangoon to Prome, to Henzada and Bassein, and from Pegu to Moulmein and Ye; the Japanese Moulmein-Bangkok line has not proved worth continuing.

(*c*) By an elaborate coastwise traffic of small sailing and steam vessels, centring on Rangoon.

(*d*) A road from Rangoon to Mandalay and Lashio crisscrosses over the railway and duplicates its function. Roads have later been pressed into the Shan States on the east and to Prome and the oilfields on the west. In general, the road system in Burma has remained undeveloped, sketchy and frequently dead-end.

Chapter Twelve

THE EAST INDIES

THE WESTERN ARCHIPELAGO—SUMATRA

The East Indies

The East Indies will be treated as that group of islands lying off Southeast Asia from the Sulu Sea southwards and terminating at Weber's Line, west of New Guinea. Broken down into some minute units of land, the whole group has been subject over the last few centuries to political administration by the Dutch (with the exception of North Borneo), a fact upon which is largely based the conception that the archipelago is a geographical unit, though the Indonesian region is one of broadly similar ethnic groups dispersed through a sprawling island world, of similar physical environments and of similar human adjustments to it.

The East Indies is the one example of large portions of equatorial environment sufficiently penetrated by stretches of sea to make them accessible, so that human beings have been able to enter the region easily and to experience the environmental factors at work. The human response has varied widely; the teeming millions of Java contrast with the forest-covered emptiness of Borneo, and the barbaric tribes still wandering in the mountains of Sumatra scarcely relate to the elegance and refinement of Balinese cultural life.

That the archipelago stretches through 2,000 miles has effectively kept apart the people of individual islands whose forested terrain operated also to isolate coastal people from those of interiors. Against these impediments have been working the ease and fluidity of movement by water, on seas smiling and benevolent for weeks at a time, on rivers, the only natural paths through forests and swamp, and on sheltered lagoons behind the coast. The waterways that provided the easiest lines of movement for indigenous people made this zone equally accessible to foreigners, obliged to travel among the islands by reason of the long Malay Peninsula thrusting far south of the Asiatic mainland, so that people of India,

China and Europe have moved freely for millennia among the islands, adding to the mixture and diffusion of diverse ethnic and cultural types and stages of technological development. None of the islands has height sufficient to create large areas of other climates or vegetation which might breed special human types, but the volcanic highland zones of young fertile soils have drawn to themselves very dense populations of intensive agriculturalists who have pressed farming almost to the lips of active craters, a single outburst of which may therefore bring calamity to hundreds of thousands of people. Political power has, in Java particularly, centred round the productive volcanic zones; other political units have centred on the coastal fringes, to form amphibious political units rather than units of land.

With the justification of geomorphological, faunal and floral differences, the Indonesian islands may be subdivided into: (*a*) The Western Archipelago, to include Sumatra, Java, Borneo and other islands related to the Sunda Platform, a group where routes between major parts of the Asiatic continent have converged to make a strong impression on local ways of living, especially by introducing modern commerce; and (*b*) the Eastern Archipelago from Bali and the Macassar Straits eastwards to Weber's Line, a group of youthful structures off the track of international routes, much less influenced by Asia and little touched by modern commerce.

In the following discussion of Indonesian regions, Dutch phonetic renderings of local place names will be used. These differ from English renderings of similar words in Malaya but are best retained for easier reference to maps and sources.

The Western Archipelago

Although Borneo is by far the largest of this group, most interest attaches to the much smaller island of Java where the greatest population and the intensest cultivation have evolved. Sumatra is in these respects intermediate in type between Borneo and Java. Small islands like Banka and Billiton have significance only for their tin mining.

Sumatra

(*a*) *Physiography*

About 1,600 miles long and fairly equally divided by the Equator, Sumatra is itself surrounded by islands. Paralleling it

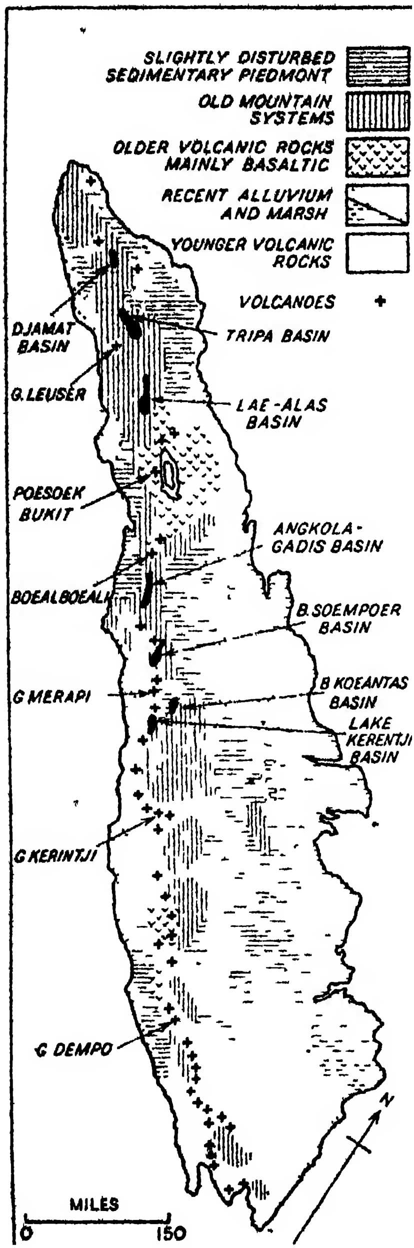

FIG. 63.—Landforms of Sumatra

in the Indian Ocean are the Nassau - Mentawei islands, mountainous, neglected, thinly peopled and off the track of world interests. On the Malacca Strait side are flat, marshy islands slowly building up seaward, and progressively linking by sedimentation to the Sumatran mainland. Farther east still are the islands of the Sunda Sea, submerged extensions of Sunda Platform ranges in Malaya. The ranges of Sumatra extend northward as the islands round We and southward into the Sunda Strait where the great Krakatau volcano marks the meeting place of lines of tectonic weakness running lengthwise through both Sumatra and Java. None of these marginal islands supports many people. The Sunda Platform, mostly concealed by sediment, lies roughly east of a line between Tandjoengbalai to Oosthaven.

Sumatra is remarkable for the huge flat alluvial lowland extending along two-thirds of the East Coast, from Tandjoengbalai southwards. This region, a forest-covered swamp masking the edge of the Sunda Platform and merging into the shallow

Malacca Strait, is an obstacle to settlement and approach from the east, sparsely inhabited and undeveloped, the longest and most continuous example of Southeast Asia equatorial swamp still beyond the control of human technology. More than any other single factor, this repellent East Coast has operated against the development and peopling of Sumatra. These alluvial swamps in places extend inland for as much as 150 miles, and are chiefly responsible for the bulging shape of southern Sumatra today.

The Sumatran mainland (Fig. 63) is formed by a complex series of mountains well to the west, establishing a watershed rarely over 35 miles from the Indian Ocean. It has no generally accepted name except in the southern two-thirds where it is called the Barisan Range (Barisan means "line of hills"); to the north the terms Atjeh and Batak Highlands apply.

These mountains and the plateaux they enclose are partly tilted from west to east so that a mountain wall, edged by raised coral beaches and trenched by short, violent streams, forms the western landscape, hindering approach and human development on that side. Throughout its length the mountain system has been accompanied by faulting to produce longitudinal rift valleys arranged as a discontinuous trough through most of the mountain region, from the Basin of Goja and Alas in the north to Semangka Bay in the south. The Angkola-Gadis (Padangsidipoean), Upper Soempoer, and Fort de Kock (Bukit Tinggi) depressions are other basins along the medial trough.

To this triple division vulcanism has added the complication of lava outpourings of several ages and types, from andesite to ash. Erosion by the torrential rains has carved and removed much of the older lava yet large deposits of it remain in the south and at points on the west. Most of the outflow seems to have spread east as great sheets of pumice, tufa and ash, partly in the original state, partly redistributed as water-borne alluvials. The East Coast swamps are largely built of redistributed debris from more recent volcanic eruptions of South Sumatra. In the Batak Highlands tufa from recent vulcanism has obliterated all earlier relief over an area of some 5,500 square miles; south of Sorikmerapi occurred another large outflow of lavas. One effect of these outpourings of volcanic material has been to block parts of the medial trough, interrupting and diverting its drainage for a time, often creating temporary lakes which have left fertile alluvial basins attractive

to farming and accessible only through gorges at what was the debouchment of the lake, as at Lake Tawar. The whole drainage pattern is one of interaction between the alignment of the medial trough, the general tilt eastwards, and the tongues of volcanic debris.

Between the mountain system and the East Coast is a strip of piedmont varying in continuity through the length of Sumatra. It has a distinct character set by only lightly folded sedimentaries crossed from the west by entrenched streams, and containing oil-bearing substructures exploited at various points from Atjeh to Palembang. This piedmont comes almost to the coast north of Medan, to narrow the line of coastal swamp, but it stands well inland elsewhere.

In the Batak Highlands, the volcanic outpouring of acidic rocks 2,000 ft. thick has concealed the medial troughs and the adjoining eastern piedmont down to the East Coast. Huge dormant cones still stand on the inner Batak landscape round Lake Toba. Steeply graded rivers have cut gorges to break up the plateau-like landscape, and carried the easily eroded volcanic debris towards the east coast; upon these transported soils has grown up the plantation agriculture (Fig. 66) west and south of Medan. In contrast to the acidic rocks elsewhere on the Highlands, from the dormant Batak volcanoes in the north came basic ejecta, weathering into fertile soils which alone make possible the tobacco plantations behind Medan. Elsewhere the acid volcanic cinders have spread a porous mantle on the plateau, upon which the normal Tropical Rain Forest will not grow, so that a semi-arid savannah vegetation scattered with giant ferns covers the landscape. Probably, too, this zone has been overcut by shifting agriculturists and regrowth of the secondary forest hindered by soil porosity and by the dry föhn winds coming across the mountains from the south and east. Lake Toba, 50 miles long, 3,000 ft. above the sea and covering over 500 square miles, is surrounded by cliffs often 2,000 ft. high, at the foot of which are narrow alluvial belts intensively farmed for rice; its outlet to the southeast (Soengai Asahan) plunges through tremendous gorges.

Farther south from the Batak district, the dormant Boealboeali volcano is the first of the Barisan Mountains where the typical form of two ranges separated by a series of fault depressions becomes emphatic. These depressions are swampy or occupied

by lakes. The Western Range, built of recently dormant cones and less resistant volcanic materials, presents a torrentially scored face to the Indian Ocean where only scanty and small alluvial fans, separated by cliffed headlands, attract settlement. In the Eastern Range appear more resistant metamorphic rocks, schists, slates and limestones, descending less steeply to the east and enclosing a few depressions, such as the Batang Oembilin Basin, site of the chief Sumatran coalfield, linked by railway to Padang.

At about 1° 30″ N. the whole mountain structure narrows to a low waist not more than 20 miles wide through which it is possible to cross without rising above 2,000 ft., at Padang Sidimpoean. A highland road threads the medial trough from this small town through the Angkola and Soempoer Valleys to the Fort de Kock Basin, thence splitting to traverse the West Coast southward from Padang and the eastern piedmont to Djambi, Palembang and Lampoeng Bay. Lake basins are present in this section of the medial trough (Manindjau and Singkarak) each fringed by minor agricultural areas.

South from the Batang Hari rises first the active Kerintji volcano (Piek van Indrapoera), highest and most naked peak in Sumatra (12,470 ft.), and thereafter volcanic cones, mostly active, dominate the landscape as far as the Sunda Strait. Granite, crystalline lavas and tufas spread everywhere. Where the medial trough appears, its alluvial fillings attract cultivators and settlements, but transmontane routes are few. In this zone begins the great Air Moesi which, very mature in contrast to most Sumatran streams, is at this stage broad and shallow, with gently sloping sides. Many of the volcanoes of South Sumatra discharge tongues of mud (lahars) which drain into the lowlands.

Half the area of Sumatra lies on the plains east of the Barisan Ranges and does not exceed 100 ft. in altitude. Apart from the piedmont, where oil and coal frequently occur, the recent alluvium from the volcanic highlands plasters all other formations. Since mangrove and tropical swamp are progressive growths, there are by now some slightly higher and drier sections, well away from the rivers which, heavily laden with mud and decaying vegetation, have lost the power of vertical aggrading so that they abrade sideways to form constantly changing courses and to leave numerous abandoned channels quickly choked with thick-matted vegetation. Much of the swamp is inundated each rainy season, and twice

Fig. 64.—Land Use in Sumatra

daily the large deltas and a zone up to 12 miles broad along the coast may be flooded by tides. While the rivers across the swamps are navigable to some extent, depending on shifting sand-banks, villages along their banks are separated by great distances. Some of the channels near the coast are surprisingly deep, probably due to tidal scour; the Kampar, for example, has a powerful bore. The navigable streams establish an E-W. line of communication, met inland on the piedmont by roads and a railway with a NW-SE. alignment. The natural vegetation is of two types: (*a*) Tropical Swamp Forest, predominating in the eastern half of the island, and (*b*) Tropical Rain Forest, occupying most of the rest of the island, with a few variations due to changing altitudes and porosity of soil (Fig. 64). Along the East Coast, corals do not appear, inhibited by the muddy shores and extensive mangroves. On the West Coast there are both live corals and coral terraces on raised beaches.

(*b*) *Climate*

Sumatra's climate broadly resembles that of Malaya. The high mountain barrier induces very heavy rains (over 150 in. p.a.) at all seasons with maximum during October-November north of the Equator and during December-January south of it. Seasons of less rain (not amounting to drought) are more pronounced to the

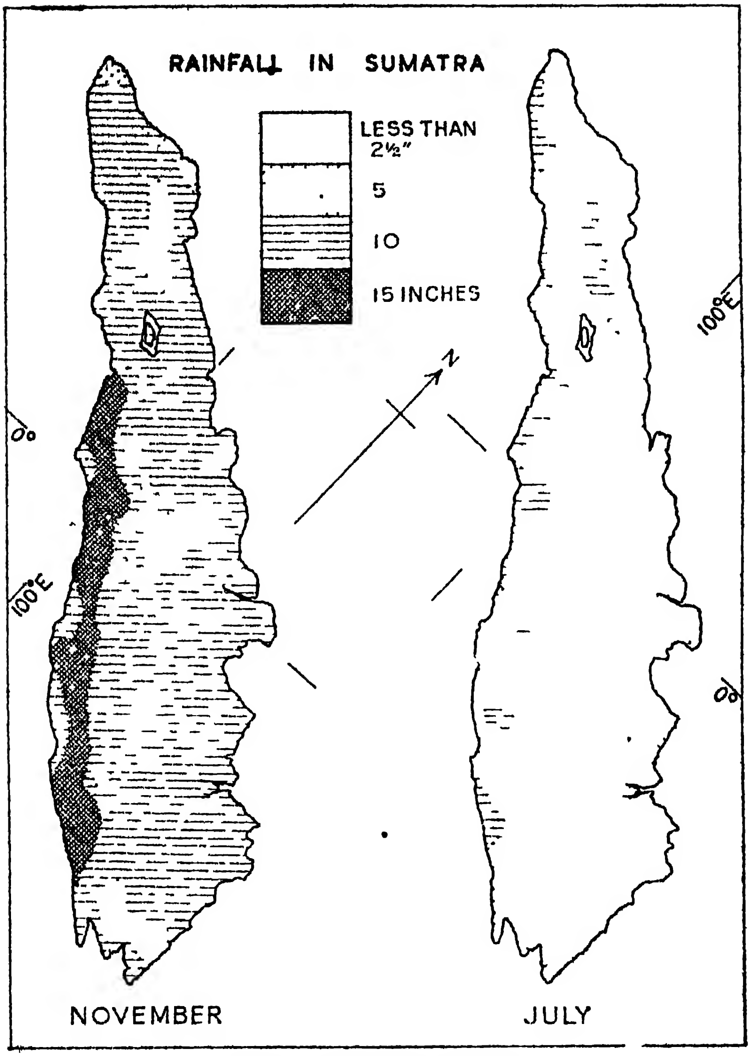

FIG. 65.—Rainfall in Sumatra

north (as in North Malaya) and some of the mountain basins have low rainfalls because they are shielded from rain (Fig. 65).

Considerable differences of weather from district to district occur in the Barisan Ranges where föhn winds are very pronounced on the eastern flanks during southwest winds. Cool drier climates upon some of the plateaux create minor variations in the equatorial

régime of violent convectional rains and uniform warmth. Strong, east-moving squalls, the "Sumatras" of the Malacca Strait, blow most frequently across the north in January; to the far south they reach a peak in August on the West Coast, in July on the East Coast. No tropical cyclones have been recorded.

SUMATRA: AVERAGE RAINFALL (inches)

	Rain-days (over .02in.)	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Bukit Tinggi (3,018 ft.) ..	195	9	7.2	8.4	9.9	7.0	5.4	3.7	6.0	6.7	8.7	8.7	9.6	90.3
Padang (230 ft.)	190	13.4	10.9	11.4	14.3	12.0	12.8	10.9	13.4	16.4	19.4	19.9	18.7	173.5

(*c*) *Population Patterns*

Medan, the most populated district of Sumatra (Fig. 66), has a density equal to that of the least densely peopled part of Java —that is, between 150 and 300 persons per square mile. This contrast, while reflecting physical differences, relates also to accidents of recent historical developments. In the Hindu colonisation period travellers visited Sumatra frequently, recorded the relative grandeur of principalities centred there and did not suggest that the contrasts between Sumatra and Java were so great as they are now. During the last few centuries, Sumatra has been off the track of the international trading interests threading these seas, and the East Coast swamp and the West Coast cliffs made it far more difficult to approach the populated interior than was the case in Java. Operating to its disadvantage also was the late arrival of modern organisation and transport systems; Sumatra only came under Dutch control early this century. The island escaped that impulse to population expansion, the Culture System, which had much influence in Java last century, and it has never in modern times attracted large-scale immigration. These are negative factors. Probably the present population (8.3 million in 1938), an average density of 44 persons per square mile, indicates a condition likely to have been repeated in Java had positive factors not operated there.

The pattern of people in Sumatra may be summed up thus. The densest population spreads behind Medan; somewhat lesser densities cover the Fort de Kock basin, the adjoining depressions of the medial trough, and the Batak Highlands. Fringing the

northernmost and southernmost tips, in the fertile little estuarial bays of Atjeh and Lampoeng, are minor concentrations of people. Least populated is the East Coast swamp where over large areas there are densities well below 25 per square mile, indicating that the same swamp has acted as a major barrier between the people

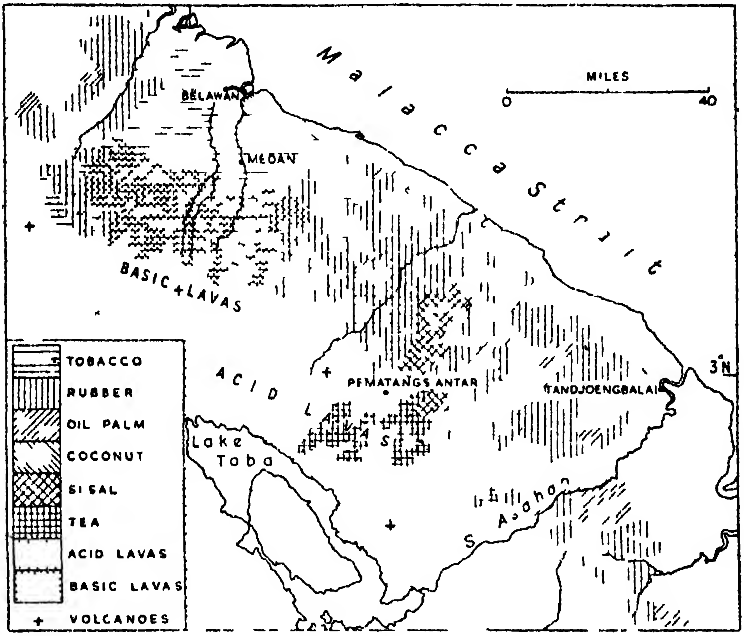

FIG. 66.—Correlation of Lavas and Agriculture behind Medan

of Malaya and Sumatra, more so than the Malacca Strait itself, which is a means of contact for sea-going people. Fertile soils of basic lava origin are found only in Lampoeng, in the foothill country west of Palembang, in the Padang Basins, and on the Batak Highlands, all attracting agricultural populations. Only 16 towns, mostly peripheral, as in the case of Palembang, Medan and Padang, have over 10,000 people each.

Menggala is the centre of a fairly prosperous farming region whose population barely reaches 60 per square mile. In the middle and upper valleys of the Air Moesi, the alluvial soils and the controllable water supply permit rice farming, flanked by rubber and coffee plantations; this zone attracted interest because

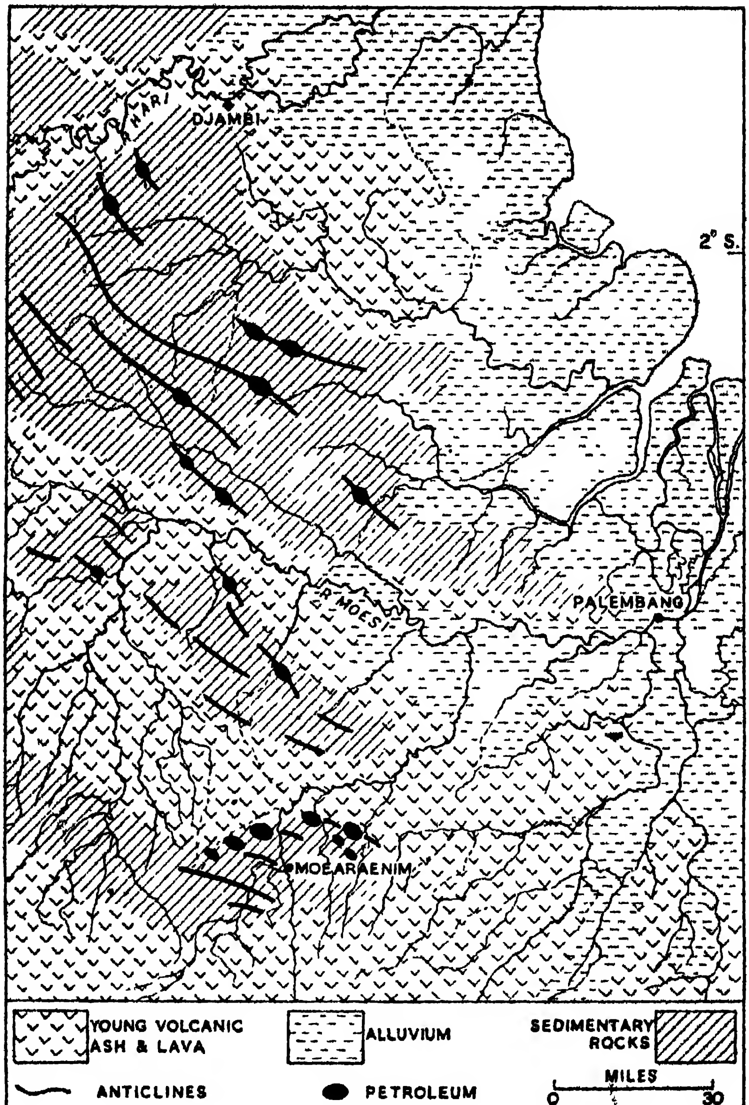

FIG. 67.—Petroleum Deposits near Palembang

it is near productive oil wells (Fig. 67). Palembang (population 110,000), where a line of low hills approaches the Moesi, has been the chief centre of this region for long historical periods; although the settlement was mentioned by early Indian and

Chinese travellers, its modern revival as almost monopolist commercial centre of Sumatra is connected with the oil refineries of Pladjoe nearby and its accessibility from overseas by ocean steamers and from Central Sumatra overland through the piedmont. Djambi has a rather similar location and historic value with respect to the Batang Hari river. The Bukit Assam coalfield, linked by rail to Palembang, has special postwar significance for this region deficient in coal supplies because it resumed production quickly (360,000 tons for 1948).

Where the eastern piedmont comes to the coast, on either side of Medan, relatively dense populations have settled recently in connection with tobacco, rubber, coffee, tea and oil palm plantations. Medan itself (76,000) originally developed into the regional capital because, located on the Soengai Deli, riverine and coastwise routes centred there. Shipping difficulties in so shallow a river made necessary in course of time the creation of an outport at Belawan, which handled mainly an export trade of bulky primary commodities (1950 exports 250,000 tons, imports 105,000 tons). Belawan once dealt with more shipping tonnage than any other Sumatra port, multiplying its tonnage five times over the inter-war period, but was used by less than a million tons of shipping during 1947; it suffered from much silting during the Japanese Occupation.

Few mountain districts in Sumatra have more than 50 people per square mile, and though the youthful soils round the Kerintji volcano rank as well peopled, the density of that region is only 70 per square mile. A longitudinal highway links the various medial troughs, encouraging their agricultural development. Among the Padang Highlands there is more intensive settlement than elsewhere in Sumatra, based on the fertile volcanic soils round Merapi. Thus densities of over 850 people per square mile occur in the Fort de Kock (Bukit Tinggi) country where tobacco, coffee and coconuts are grown. Nearby at Sawahloento, coal is mined. This dense population extends to the west coast where Padang (52,000) is chief town of West Sumatra and third in the whole island. Even here, however, a sheltered outport, Emmahaven, has had to be built farther south because Padang's shallow and unprotected harbourage does not suit modern shipping. To Emmahaven, often broadly included in the name Padang, was routed for export the agricultural produce of the Highlands and the

prewar output of the Oembilin coal mine, one of the few sources of coal regularly available for archipelago railways and shipping. Transport proved a costly overhead to these remotely located coals which, after railing to seaboard, still have considerable distances to cover before reaching convenient selling points at Sabang or in Java. The Batak Highland is the only other mountain zone with fairly dense settlement (over 200 persons per square mile). It has good links to Medan and to Sibolga. The Batak setting has not only stimulated a vigorous agriculture among local people, but also encouraged "hill station" development round Lake Toba.

(*d*) *Human Types*

While numerous clan groupings developed here where evolution in isolation was facilitated by the terrain, two ethnic types settled in Sumatra. Long-headed Caucasoid types (Nesiots) are represented by the Bataks, the Gajo and the people of the Nias-Mentawei islands. Broad-headed Mongoloid types seem to have migrated hither from Continental Asia, by way of Malaya, and may be recognised today among people of the Sumatran East Coast, the Menangkabau and the Atjeher who fringe all the northern tips of Sumatra. Among Sumatrans no less than fifteen languages and a wide range of dialects are in use today; though their customs vary, they are variations on a similar pattern closely associated with the uniformity of environmental conditions.

Three groups of peoples may be distinguished:

(*a*) *The Menangkabau*, distributed from the middle of the island to the West Coast. This is a people more broad-headed (Mongoloid) than neighbouring groups; Menangkabau are Muslim now but retain their older matrilineal social system and its strong family ties which have led to the housing of many branches of the one family under one roof, and to customs resembling those of the Hindu family system, calculated to keep family property intact. The elaborately-decorated quarter-moon-shaped houses evidence a fairly high cultural standard, producing skilled wood and metal work. Menangkabau agriculture has considerable complexity, based on wet paddy and buffalo breeding. The Menangkabau have a commercial reputation as the only Sumatran community astute enough to be able to hold its own in trade against the Chinese middlemen established everywhere else in the island.

To the east of the Menangkabau, other types of Malays live on the East Coast and its adjoining islands. They are Muslims with a patrilineal system and they gravitate towards village sites close to tidal water. Some Malays near Palembang have a tradition of originating from Malacca. They are not located well enough to be more than indifferent agriculturalists but they are active fishermen, among whom much overseas influence is apparent.

(*b*) North and south of (*a*) are *Batak and Lampoenger*. The word Batak, originally a derogatory Malay term, covers a number of tribes of the uplands round Toba and reaching to the west coast at Natal. These people are chiefly influenced by Hindu and animistic traditions, though conversion to Islam and Christianity has taken place among southern tribes. Patrilineal inheritance and class distinctions, related to the caste system, govern Batak customs, which are associated with multi-family houses and a subsistence agriculture now emerging from the shifting cultivation type. The Gajo people of inner Atjeh resemble the Bataks yet they have been subject to Atjeh influence long enough to adopt many Atjeh ways.

Lampoeng people have had long associations with the Bataks, weakened now by influence of Sunda people from across the strait and by the belt of Malay peoples stretching east-west through Middle Sumatra. Though Muslim, they are not far from the head-hunting stage. Their several-storeyed houses are distinctive, each standing in its own stockaded compound on high piles. They are almost vegetarian and have an elaborate literary culture.

(*c*) *Atjeher.*—The Atjeh people comprise many tribes among which there are marked differences between more agricultural coastal types, much influenced by foreign contacts, and the more mobile interior types. Atjeh was invariably touched by the peoples crossing the Indian Ocean over many centuries and it has had longer associations with Arabia and travellers from that direction than with any other single foreign interest. It was historically the first part of the Indies to become Muslim. All peoples of the group ha ‹ an aristocratic society whose fanatic Muslim tradition has welded them into a community which fiercely resisted subjugation by outsiders in modern times. Atjeher land is tribally owned but individually

cultivated on a subsistence basis. The influence of Arab traders has been very strongly superimposed upon much older cultural traditions.

In addition to more settled communities, there are in Central Atjeh very primitive peoples resembling the wandering tribes of inner Malaya. Incompletely Muslimised, they are hunters, gatherers and fishermen. Odd migrant tribes of shifting agriculturists have been found farther inland but the nomadic hunter-gatherer types predominate. Among the non-Muslim Mentawei-Nias islanders, Polynesian affinities are very marked and cultivation is based on yams.

Upon this pattern of indigenous people has been imposed the more recent immigration induced by modern agricultural mining activity, bringing Chinese labourers into the Medan district and into Palembang. In 1938 Sumatra contained 450,000 Chinese who were prominent as plantation and mining workers, as fishermen at Bagansiapiapi, and as retailers and middlemen in nearly all the towns.

(e) *Land Utilisation*

Most of Sumatra remains under its natural vegetation cover (Fig. 64), the Tropical Rain Forest being interrupted only by patches of secondary forest and savannah where local soil conditions are inferior. The largest patches of secondary forest are upon the eastern side of the southern mountain system (west of Palembang Residency) and marginally round all agricultural zones.

Indigenous agriculture continues to be more dependent on shifting cultivation than on sedentary farming. Hence the zones of densest indigenous population are being extensively cut over by the predatory shifting system, accounting for the fringe of savannah round all settlement areas. So far the population has not reached a density sufficient to weaken the tradition of shifting cultivation which now supports about 6 million Sumatrans. Many of the people still depend on roots, the typical indigenous interest of local cultivation. Rice and maize, which the more developed groups cultivate, are definitely the result of external contacts and practised close to lines of external communication.

Wet paddy farming is confined to a few deltaic embayments on the Atjeh coast, and to the upper valleys of the Moesi and Hari rivers on the flanks of Kerintji, as vestiges of the prosperous

principalities of the first millennium when Indian colonisation reached its peak. Elsewhere dry paddy on temporary forest clearing is more usual. There are a few permanent rice-producing zones scattered round the Lampoenger coast. These agricultural activities are on a subsistence basis, yet Sumatra as a whole is not self-supporting even in rice, so that maize has become well established as secondary food crop. Only in the Padang Highlands has a more intensive indigenous agriculture produced rice for local commerce. In Atjeh and Lampoeng rice acreages have rapidly expanded over recent years, made possible in Lampoeng by soil rejuvenation from last century's Krakatau volcanic explosion which spread fertile ash in south Sumatra. Much of the difficulty of agricultural expansion has been the scarcity of people. In modern times, officially encouraged immigration to Sumatra has been slow and reluctant even from nearby Java which faces the problem of too many people and inadequate land. The zones of immigrant settlement were chiefly near Lampoeng; by 1929, 45,000 Javanese had settled in Oostkust Residency and 30,000 in Lampoeng and Bencoelen; by 1941 there were 117,000 in Lampoeng, 14,500 round Palembang and 7,500 in Bencoelen. These Javanese immigrants needed to be farmers to be suitable as permanent settlers, yet they were wanted as labourers upon European plantations as well. Under this double demand for labour, the expansion of Sumatran food agriculture scarcely kept up with the rate of immigration. Once caught in the system of cash farming, immigrants became smallholders of rubber, in imitation of the chief European plantation interest.

Rubber ranks as an important crop of the indigenous farmers of Sumatra, a development fitting in both with the shifting cultivation when undergoing transition to sedentary farming, and with cash crop farming. The smallholdings are worked partly for food and partly for rubber. Other crops grown by smallholders for cash are tobacco, coffee, tea, kapok, coconuts and pepper. The actual acreage under rubber, the chief smallholder cash crop, cannot be listed accurately because the units are small, widely dispersed and irregularly worked. The most convenient index comes from Sumatran statistics of smallholder rubber exports which from nothing prior to 1915 grew to 61,000 tons in 1929; this included 22,000 tons from Djambi, 16,000 from Palembang and 14,000 tons from the northeast coast. A rough estimate of

the smallholding acreages may be made on the basis of 15 acres producing a ton of rubber.

Sumatran agriculture has not closely followed the Malayan pattern. European-capitalised plantations under foreign management began late last century. The oldest (1863) were for tobacco in the sultanate of Deli behind Medan, where high-quality tobaccos are still grown in plantations totalling 32,000 acres upon basic lava soils. Large rubber plantations gradually occupied lands adjoining these old tobacco plantations and now exceed them in importance. Similar large rubber plantations were established inland from Palembang and Djambi. Even during the confusions of 1950, .40 million metric tons of rubber were purchased from Sumatran smallholders as compared with the estate production of .14 million tons. The Medan area (Fig. 66) has a diversified plantation agriculture rather than the monoculture typical of Malayan plantations and oil palm, tea (particularly near Pematangsiantar), coffee and sisal estates alternate in strips roughly at right angles to the coast to take advantage of transported volcanic soils. Attracted by these plantations, considerable numbers of Chinese labourers have immigrated into the countryside round Medan.

Most mines were also largely worked and managed by foreigners. The Atjeh and Northeast Coast oil wells were handled by refineries at Sabang and Medan, those farther south at Palembang and Djambi. Much of this oil went to islands near Singapore for final distribution. In 1940 over half the Sumatran crude oil production (5 million tons) came from the Pladjoe fields and another quarter from Djambi. During 1950 a total of six million tons of crude oil was again being exported from Sumatra. Chinese miners have regularly washed for gold in the alluvials of West Sumatra, the output being more important as a legend than it is in fact.

Singkep, Banka and Billiton

Offshore from Sumatra and connected with it administratively are the islands of Singkep, Banka and Billiton whose over-mature relief repeats that of Malaya. They are the largest of that maze of small coral-girt, granite-cored, thinly peopled and almost uncultivated islands known as the Rhio and Lingga archipelagos, scattered south of Malaya, restricting movement of shipping now,

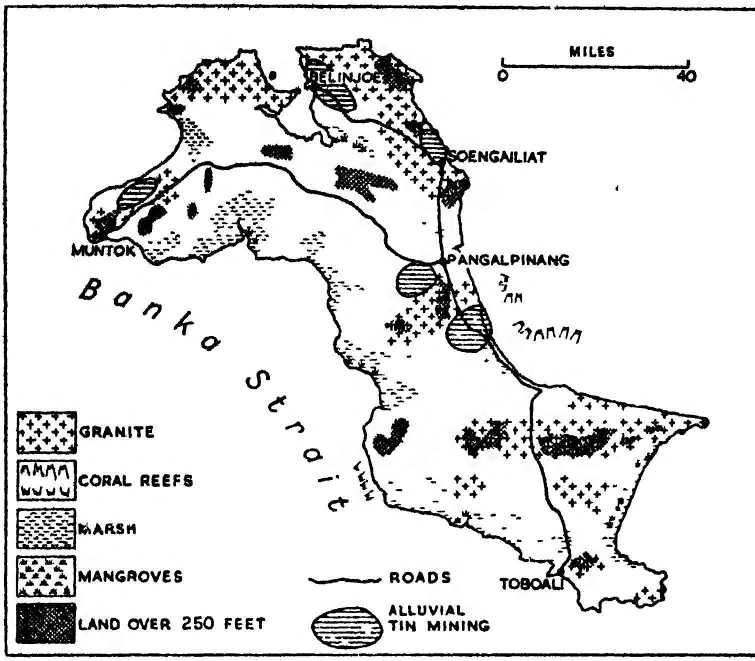

FIG. 68.—Banka. This island is almost entirely forested except where mining is carried on

though they facilitated the inter-continental movement of people for millennia in the past. The form of the Sumatran coast curiously parallels those of Banka and Billiton (Figs. 68 and 69). These two islands have rich alluvial tin deposits under conditions recalling those of the Kinta Valley though here partially deposited in the sea—hence locally known as "sea tin." These alluvials have been worked by dredges and some lode tin was mined in Billiton up to 1942. Large colonies of Chinese labourers have settled on these mines as temporary immigrants; of 115,000 persons on Banka in 1940, 43,000 were Chinese and there were 20,000 Chinese among the 58,000 people on Billiton. Up to 1932 some smelting was done on Banka though the bulk of ore went to the big smelters at Singapore, until Dutch political considerations caused the building of a smelter at Arnheim (Holland) to short-circuit the processing in British territory. Activity on these mines has fluctuated with world prices. Of about 44,000 tons produced by them in 1940, over half came from Banka, and a third from Billiton. Their combined production was back at some 32,000 tons for 1950.

From Poelau Bintan in Rhio bauxite was extracted prewar (275,000 tons 1938), but only restarted in late 1947 for delivery to U.S.A.

Farther south, the volcano Krakatau has little significance in

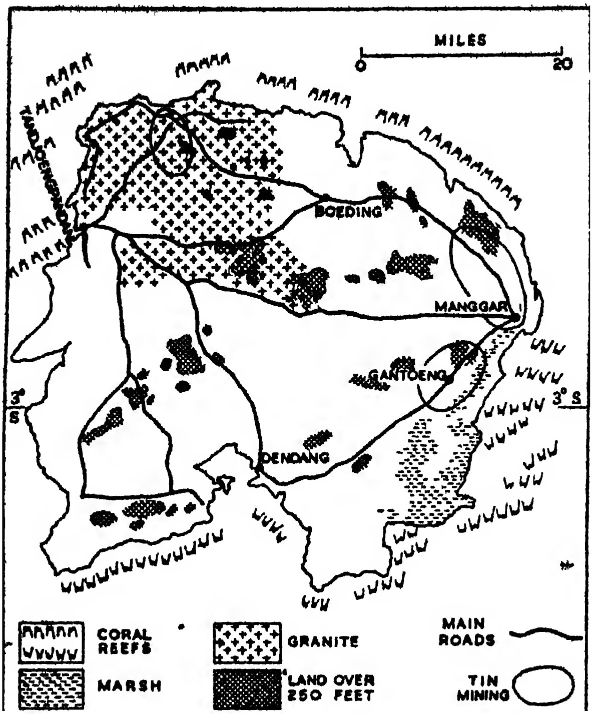

FIG. 69.—Billiton. Apart from mining areas the island is forested

human geography, although it is notorious for a tremendous outburst in 1883 which, by spreading ash over huge areas of South Sumatra and as far as Singapore and Batavia, exemplified what devastation and changes by inundation and by covers of ash can be produced within a short while in the unstable sectors of the archipelago.

Transport

While much of the East Coast is repellent to settlement, transport now gravitates in that direction on account of the navigable rivers leading to the international artery of the Malacca

Strait. Thus, Singapore, not far from the middle of the East Coast, has tended to be the focus of Sumatra's external trade, especially as link to Europe, and as port of call for shipping moving from all East Coast ports to Batavia, the administrative capital of the archipelago. The configuration of the Strait led local and international shipping through the narrows close to Singapore whose long-standing significance in relation to Sumatra was reflected by the Japanese device of making Singapore the administrative capital of both Malaya and Sumatra.

Chapter Thirteen

THE EAST INDIES

THE WESTERN ARCHIPELAGO: THE NATURAL LANDSCAPE OF JAVA AND MADOERA

JUST over 600 miles long, the prolific island of Java is set slightly askew to latitudes and located farther away from the Equator than the most northern parts of Malaya. It tends to have an emphatic dry season and a rainfall diminishing east of a meridional line through Goenong Merapi, though these tendencies are overridden in detail by relief. Middle Java (Cheribon to Semarang) scarcely exceeds 60 miles in width, but east and west of this "waist" the island broadens to about 100 miles, so that its form is distinctly elongated, emphasised by a lengthwise arrangement of the structure and the landscape types, whose continuity is more pronounced to the south than to the north. The island of Madoera, always bracketed with Java administratively, is a structural extension of North Java.

Beginning from the south, the landscape types may be summarised thus (Fig. 70):

1. The south coast limestone platforms.
2. The medial "ridge and valley" belt of disturbed sedimentary rocks.
3. The line of volcanoes forming the axis of Java.
4. A belt of alluvials from Bantam eastwards through the Loesi-Solo valley to the Madoera Strait and enwrapping the volcanoes.
5. The North Coast limestone platforms of Rembang and Madoera.

THE SOUTH COAST LIMESTONE PLATFORMS

Five platforms, a small one in S. Buitenzorg, a large one in S. Priangan, the extensive Goenong Sewoe between Kali Opak and Patjitan Bay, the plateau between the bays of Popoh and Sipelot, and an eastern outlier forming the Blambangan Peninsula, a built of little disturbed massive limestone rising precipitous

from the coast and forming a landscape of tropical karst type. The formation is thick and porous and its subterranean drainage leaves the surface generally waterless and barren, negative to agriculture and to population. Goenong Sewoe sets the type, as a platform rising to about 1,000 ft. in a series of steep bare hills and hollows, uncrossed by modern routes. Those platforms to the west receive regular rains and have a more profuse vegetation, while those to the east serve to emphasise the arid note on a landscape naturally subject to a long dry season.

The Medial Range and Valley Belt

The Medial Range and Valley Belt is a maturely dissected landscape on marls which give rounded relief forms. These sedimentaries which, with the limestone, cover 33 per cent of the surface, were derived on the south from eroded volcanoes of previous geological eras and have been much folded and fractured. There tends to be a medial trough among the ranges, after the Sumatran pattern, showing as various basins (e.g. Bandoeng and Garoet) to

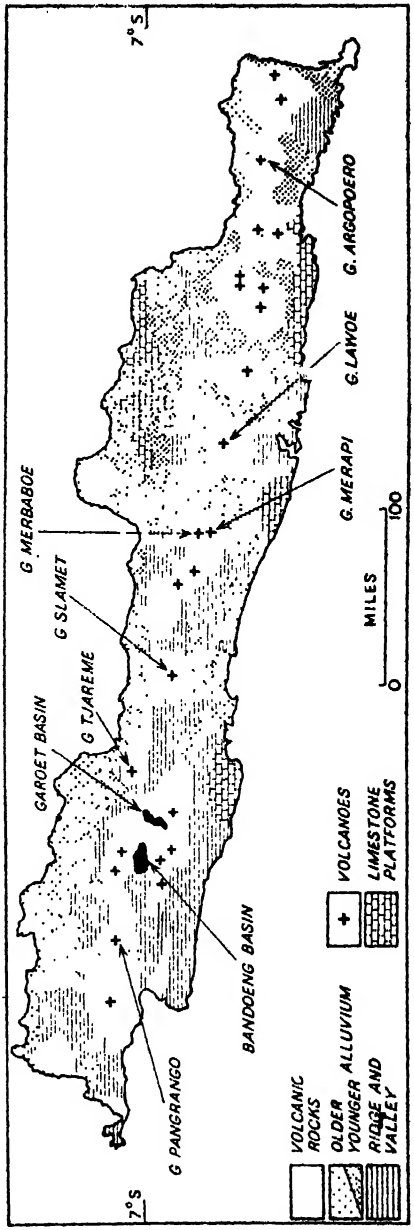

Fig. 70.—Landforms of Java

the west and as a broadening trough to the east where it opens and loses altitude until partially inundated by the Madoera Strait. The sedimentaries reach altitudes over 4,000 ft. and form the substructure of Java's highlands. They involve on the north lignite and oil deposits. To the south the highlands come to the coast as cliffs, frequently marked by raised beaches and only in a few places, as near the Banjoemas Plain, does the highland stand back from the coast behind alluvial belts. It is among these sedimentaries that fossils of "Java man" (*Homo soloensis*) have been found as evidence of the contact of this region with Asia over long geological periods. Upon these marls and associated rocks there is abundant surface water, exemplified in the rolling, maturely-eroded landscapes of Preanger, but the formations are not extensive in dry East Java and their detail is much influenced by volcanoes and the superficial material derived from them. On the north, these sedimentaries do not reach the coast.

The Volcanoes

Volcanoes dominate the Javanese landscape everywhere, disrupting the sedimentary structures (Fig. 72) and masking the older landscape forms with lava and ash outpourings. Scarcely any long distance view can be found which does not include a volcanic cone. Java's volcanoes rise in steep slopes, scarred by torrential rains, to greater heights than any other of the relief forms; 44 cones are between 6,000 and 10,000 ft., and 14 are even higher. In few parts of the earth are structural weaknesses and lava flows crowded together in such profusion. The degree of explosiveness among the volcanoes varies so that the ash sometimes builds up round the vent a steep, narrow cone with a funnel-shaped centre, and sometimes spreads farther afield. The pattern of volcanic materials depends on whether the ejecta comes as molten lava or as the ash of exploded lava; the former flows like a viscous tongue down the sides of the volcanoes, usually from a point where the crater rim is lowest, while the ash is carried as a cloud whose direction depends on the wind. Because the rainfall is generally so heavy, the effect of tropical storms and of altitude, the craters tend to become lakes. Extinct cones invariably have rounded lakes within them for a time until erosion breaks down their rim. Other craters may become explosive by reason of the steam pressure set up in them by the percolating water, or become

FIG. 71.—Physiographic Sketch of Goenong Oengaran

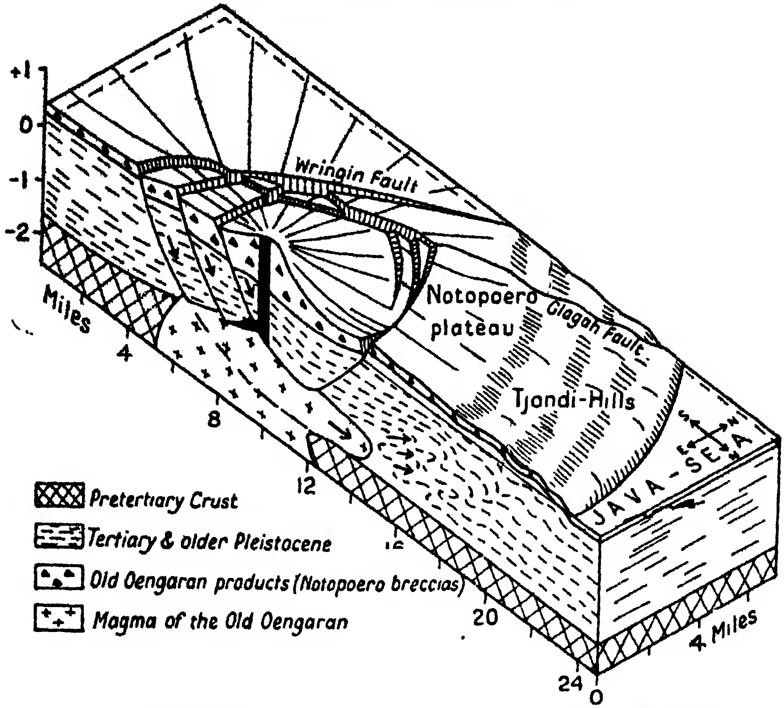

FIG. 72.—Block Diagram of the Volcanic Structure of the Old Oengaran

hot mud lakes which periodically spill over as lahars, devastating the countryside round the volcano, or emit ladoes, which are scorching clouds of hot dust of equally devastating effect. Gas vents (fumaroles) and hot springs of sulphuretted water or mud (solfataras) occur round some Javanese volcanoes. Poisonous heavy gases may lie in valleys for long periods, converting them to "death valleys" where fauna cannot live.

Javanese volcanoes erupt more frequently with ash than with lava and when lava flows it is generally basic, so that soils on the lava and on alluvial ash derived from the lava, contain high proportions of calcium, nitrogen, magnesium and phosphorus in soluble form, to the great benefit of agriculture. Erosion, especially as great landslips, is, however, severe, because the ash is unconsolidated, the slopes steep and the rainfall heavy. All these features mean that the landscape form close to the volcanoes is abrupt and severely scored, unrelieved round the active vents by vegetation cover.

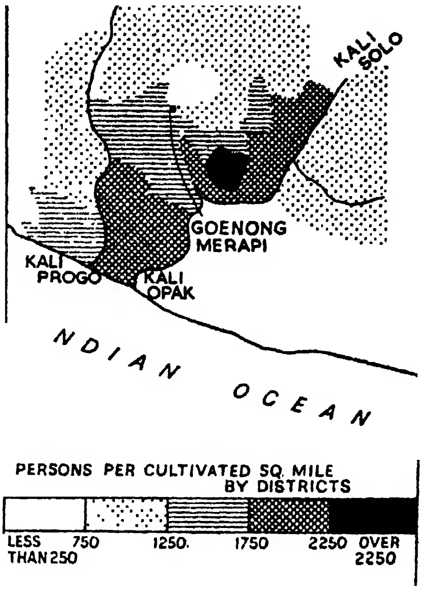

FIG. 73.—The Irregular Nutritional Densities on the Flanks of G. Merapi. These probably relate to the prevailing wind direction (from northwest) at time of ejection

Goenong Merapi (fire-mountain, a common local term for volcanoes) may be cited as example of one of Java's most destructive volcanoes (Fig. 73). Nearly 10,000 ft. high now, it was continuously active for long periods over the last hundred years. To the north, within a few miles, there towers another cone, Merbaboe. On its other side, Merapi slopes into the teeming, fertile and congested plains of Magelang, Jogjakartá and Soerakarta where intensive agriculture has been possible on the volcanic ash spread out by the torrents. Farmers push their settlements and their terraces of rice to within a few miles of the vent, so that the regular lahars, ladoes, avalanches and eruptions may cause heavy destruction of life and property. Nevertheless farmers press back again on the devastated hillsides whatever the risk, so great is the value of the volcanic soils. Close observation is kept on this volcano and siren warnings are given to the population at critical times.

The volcanic axis is inland, with the exception of Karang in Bantam and Moeria in Rembang which are volcanic outliers within a few miles of the coast. Lavas, however, reach the coast at points south of the Madoera Strait and at Wijnkoops Bay (South Bantam). In West Java the volcanoes are arranged in a loop enclosing the Bandoeng and Garoet Basins, which were lake-filled at one time owing to the obstruction of volcanic outpourings. In East Java too, the vents form a continuous group, but in Middle Java the volcanoes are in twos or threes, separated by sedimentary uplands. Most volcanoes are distributed along the medial trough which their ejecta have obliterated at many points. Only the

volcanoes of South Bantam erupt acidic lavas, largely explaining the low fertility and thin agriculture on the flanks of Bantam volcanoes (Fig. 75).

The Bandoeng and Garoet Basins merit special attention because an intensive agriculture has developed within them.

(*a*) Formerly a lake, the Bandoeng Basin, now about 800 ft. above sea level, is drained westwards by the Tjitaroem which has a gorge marking its break through the ring of volcanoes surrounding Bandoeng. Small lakes still stand in the basin which has a high fertility.

(*b*) The Garoet Basin is a similar feature separated from the Bandoeng Basin by G. Goentoer lavas. The two basins may have been continuous at one stage. Floored by fertile volcanic alluvial soils, the Garoet Basin still has vestigial lakes. Its main stream, the Tjimanoek, leaves it by a deep gorge through the encircling volcanoes. Round the Garoet are numerous tea and cinchona plantations.

THE NORTHERN ALLUVIAL BELT

Here the water-transported debris of the volcanic interior has been spread out, concealing the Sunda Platform and forming the floor of the shallow Java Sea which is steadily being reclaimed by natural sedimentation and by cultivators pressing seawards with their skilful reclamation methods. These alluvials form a fertile coastal belt west of Semarang and continue eastwards as the depression occupied by the middle Loesi-Solo rivers. Eastwards from Merapi, too, the isolated groups of volcanic cones are surrounded by alluvium. The portion of the alluvial belt to the north may be divided into two parts. The inner portion, closer to the uplands, is lined by low terraces roughly parallel to the coast, marking pausing levels in the progressive uplift associated with Java's recent tectonic history. The outer and later alluvials are flat and less than 50 feet above the sea. Between these two alluvials is a distinct terrace or break of slope though the transition is gentle in some places. Settlement, as at Bekasi for example, tends to concentrate at this break of slope, which is healthier and safer from flood than the lower alluvials. It attracts railways (the Jakarta-Cheribon Railway) and roads for the same reason. The lower alluvium is given over very largely to rice, with elaborate drainage, irrigation and water control channels threading the land-

scape and acting also as lines of settlement and transport. Rapid delta formation is still taking place at a rate increasing temporarily whenever there is an outburst of volcanic activity in the interior to provide heavy loads of ash for the rivers (Fig. 19).

The inner belt of alluvial terraces is not continuous, varying from gulfs reaching inland almost to Buitenzorg to complete disappearance, as in the Tjitaroem Valley. The upper alluvials rise in places to altitudes of 300 ft., providing a diversified landscape due to the incision of watercourses below the terrace level. Rice occupies much less of this upper surface, which must be irrigated artificially to control the run-off. Many plantations have been set in this area which has a more scattered, evenly distributed population than the lower and younger alluvials nearer the coast.

The Loesi-Solo Depression, drained both eastwards and westwards by the two rivers after which it takes its name, has an almost imperceptible watershed and a confused meandering drainage system through a number of swamps and lakes (often used as fishponds (Fig. 77). Large areas of it are under paddy, but the several limestone islands jutting through it have a teak forest cover. A fair density of people runs right through the Depression, especially along the Solo, whose banks carry almost continuous villages.

Among the volcanoes east of Merapi, the transported alluvial filling between the vents has formed zones of major human interest because they have been nurseries of Javanese culture and tradition. Large principalities grew up there on the basis of intensive agriculture :

(*a*) *The Soerakarta Basin*, part of the Solo Valley, lies between the volcanoes Merapi and Lawoe and is scored by streams so that its intensive agriculture depends upon elaborate artificial terracing to produce rice and sugar. This is one of the highly productive areas, whose soil has been frequently renewed by Merapi ash (Fig. 73).

(*b*) *The Madioen Basin* between Lawoe and Wilis-gebergte is narrow and flatter, enabling it to be well covered with permanently irrigated paddyfields. Terraces have in addition been pressed up the sides of the Basin to heights of 3,000 ft. on Lawoe. This Basin ends sharply to the south against a wall-like range of sedimentaries. To the north is the Solo River

which the Madioen River joins just before it enters its narrow course through the northern range of sedimentaries.

(*c*) Discontinuous with the Soerakarta and Madioen troughs, *the Kediri Basin* is twofold. An upper part, the narrow plain of Toeloengagoeng, lies at the foot of the Popoh-Sipelot limestone platform. The lower section, below a bottleneck at the town of Kediri, broadens northwards and eastwards into one of the most fertile rice and sugar districts of Java, with terraces carved along its sides far up the adjoining mountains. The eastern loop of the Basin, often known as the Brantas Plain, continues to the Madoera Strait, the lower, younger alluvials round the Strait being lined with fishponds.

(*d*) *The Malang Basin*, communicating by the middle Brantas Valley with the Kediri Basin, is unlike the other intra-volcanic basins in broadening to the south. It is probably an old lake basin (cf. Bandoeng) whose floor is more concave than flat, at about 1,200 ft. above sea level. There is no easy way through from this basin to the south coast and the direct road and rail route north to the Madoera Strait has been difficult owing to the steep slopes.

THE LIMESTONE PLATFORM OF REMBANG AND MADOERA

The north coast limestones of Rembang and Madoera give East Java a coast unlike that farther west. These massive limestones repeat the karst character of their counterparts on the south coast:

(*a*) A very narrow fringe of alluvial plain lines the Rembang-Bodjonegoro coast and the cliff-like limestone hills press well to the north. Much of the Rembang limestone, of which considerable areas exceed 900 ft., is covered with teak forests and there are oilfields south of Rembang itself. The width of the limestone is greatest towards the middle, tapering to a mere two miles near Brondang, where it approaches closest to the coast. Several roads and light railways cross this limestone which is in general an area of negative human interest.

(*b*) In the extensions of this limestone into Madoera, the alluvial fringe is discontinuous. Only small embayments of alluvium separate the steep limestone cliffs. Flat-topped limestone at heights of 800 ft. is nearly continuous over Madoera. Undulating relief develops upon the marly sedimentaries which

form a low central longitudinal belt through the middle of the island, yet rivers frequently run right across the island from north to south, little influenced by the marly depression. Most of Madoera has a barren aspect and its vegetation is distinctly deciduous owing to the East Monsoon drought. Farming concentrates in three alluvial pockets on the southern coast but most activity centres on coastal saltpans and fishponds.

River Systems

About two-thirds of Java drains north to the Java Sea as a consequence of the watershed lying well to the south. From Jogjakarta to G. Mohomeroe the watershed is actually only a few miles from the Indian Ocean. The relatively simple pattern of the rivers is complicated in detail by (*a*) radial drainage from the volcanoes, (*b*) old lake basins and the medial trough, which break the symmetry of streams flowing meridionally, (*c*) the E-W. fault and fold systems, which impose their lines on the rivers to make dislocated trellis patterns. The longest rivers are in the middle-east where Java is broadest. The Solo drains over 600 square miles. The Brantas is curious for turning at some place in its 340 mile course towards every point of the compass. Javanese streams vary tremendously in volume at different seasons, accounting in part for their heavy deposits at the coast. They have greatest volume from October to May when rains are heaviest, bringing floods from the torrential downpours and from the overflowing streams, despite elaborate engineering precautions. From May to September is a dry season, most pronounced in East Java, when rivers are low and desiccation prepares the soil for rapid erosion after rains begin again. Some Javanese streams have been proved to denude their basins in a day of torrential rain by as much as the Marne denudes its basin in two centuries. Part of the heavy load forms a network of levees across the northern plains.

Climate

Well into the southern hemisphere, Java receives its wind-seasons from directions differing from those of the rest of Southeast Asia. The northern tropical air arrives as northwest or westerly winds bringing equatorial downpours from October to May, which is a wet season throughout Java, rainshadow effects

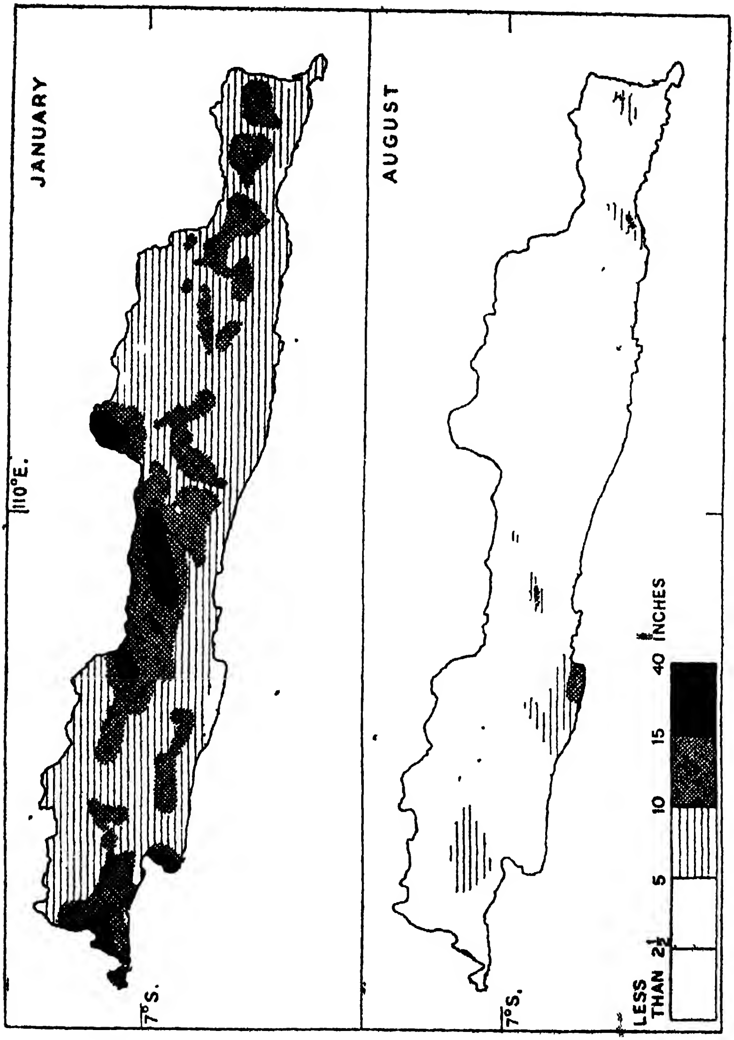

FIG. 74.—Rainfall in Java

being negligible because the high relief is conical rather than in ranges. Southern tropical air remains as southeast or easterly winds which bring to East Java a pronounced drought from these warm latitudes (Fig. 74).

JAVA: AVERAGE RAINFALL (inches)

	Rain days (over .02in.)	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Jakarta (26 ft.)	138	11.9	13.4	8.0	5.6	4.1	3.7	2.6	1.6	2.8	4.5	5.7	7.6	71.5
Pasoeroean (16 ft.) ..	94	9.6	11.8	8.0	5.2	3.5	2.3	1.1	0.2	0.3	0.8	2.5	6.3	51.6
Tosari (5,692 ft.) ..	142	12.4	14.6	10.8	6.9	4.6	3.3	1.5	1.1	1.0	3.4	7.8	11.8	79.2
Bandoeng (2,395 ft.) ..	146	7.6	7.7	9.2	9.2	5.2	3.7	2.5	2.2	3.5	6.6	9.2	8.7	75.3

Among the western mountains, particularly on the southern side, this drought is less pronounced. Rains come in violent thunderstorms which reach a peak to the north in December and to the south in May. The dry season has long sunshine periods, a factor encouraging intensive farming. Yearly rains vary considerably; in Bantam, averages above 160 in. per annum are common, while the north Cheribon Plain receives less than 40 in. per annum and all the northeast plains from 40 in. to 80 in. per annum.

Forests

Although about a quarter of Java is still forested (Fig. 75), the high population density implies that forest gives way to agriculture where at all practicable. Commercially the Javanese forests are of interest for the teak-growing on the porous and infertile limestone soils of Rembang, Semarang, Madioen and Kediri. This timber is extracted chiefly for local use, so that Java's teak export has been barely 6 per cent of that from Burma.

Chapter Fourteen

THE EAST INDIES

THE WESTERN ARCHIPELAGO: THE CULTURAL AND SOCIAL LANDSCAPE OF JAVA AND MADOERA

JAVA and Madoera have for over three centuries been associated with agricultural conceptions brought by the Dutch who imposed cash farming upon the agricultural systems traditional to the country. For most of the colonial period, this western influence aimed to obtain from Java exportable agricultural products rather than minerals, and to procure them through local farmers rather than from European plantations, although these gradually appeared. Dutch techniques have largely been responsible for the great intensity and variety of Javanese cultivation, unequalled in any other unit of Southeast Asia and representing a tropical variant upon the intensive gardening methods evolved by the Dutch in Europe. The possibilities could not have been realised had it not been for the soil conditions of Java which are largely derived, both inland among the mountains and along the coast on the river-transported alluvials, from volcanic ash of basic character which weathers to a soil of high fertility and is constantly renewed by further ejecta from the volcanoes. The importance of this renewal is evident on the flanks of Merapi, for example, which show the most intensive agriculture and densest populations where the winds prevailing at the time of ejection have deposited the ash, the windward sides being distinctly less cultivated and less populated (Fig. 73). Zones of sustained fertility are zones of constant soil renewal—hence the pressure of farming to areas as close as possible to the cones where ash deposition is most frequent, and also to those alluvial areas where streams are bringing silt from the new ash on the volcanic uplands.

These circumstances, the physical and the traditional, combine to make Java the most outstanding example of a mixed agriculture, aiming both at subsistence and at cash ales (Fig. 76) Indigenous agriculture has gradually adopted some of the crops

for export which were first introduced and cultivated on highly capitalised plantations, creating rival systems of production.

By now, shifting cultivation has nearly disappeared from Java and farming has become sedentary, though the "*desa*" system, under which communal land is periodically redistributed and re-assigned to individual village cultivators, may be looked upon as a continuation of principles once evolved among shifting cultivators. Except in the wetter, cloudier west, much land is cropped biennially so that in Semarang and Malang the area cropped is recorded as 50 per cent more than the area farmed, so great is the double cropping.

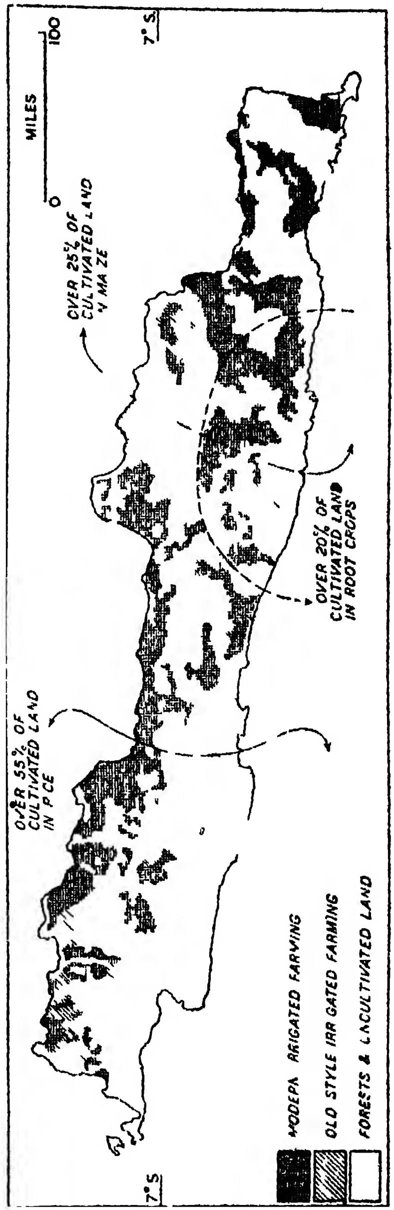

FIG. 75.—Land Use in Java

Much of the variety of crops (Fig. 76) arises from the variety of environments; tea is apt for the wet uplands of the west and sugar for the sunnier irrigated lands of the east; the flat lowlands of the north suit paddy growing, which is practised in a continuous belt from one end of north Java to the other, broken only by the teak-covered limestone plateaux, as at Rembang. To supplement the inadequate rice production for so teeming a population, tapioca and maize

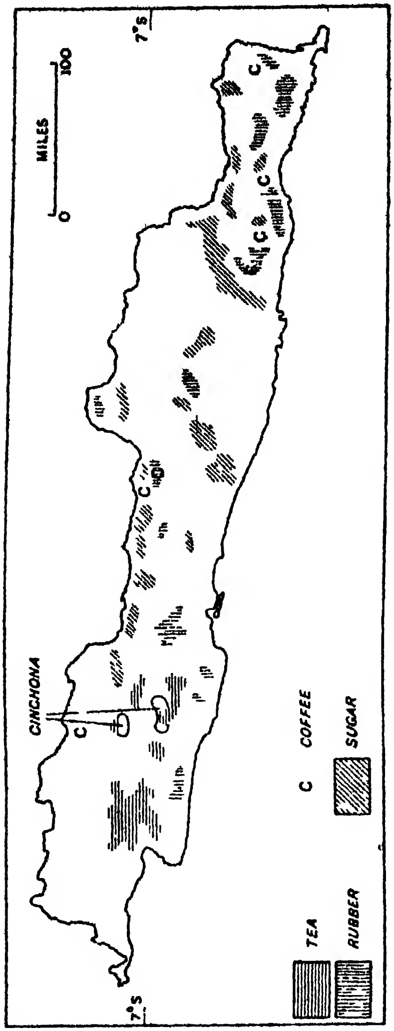

FIG. 76.—Distribution of Plantation Crops in Java

are widely grown as second crops, even exceeding the area under rice, along the northeast coast and in the eastern intra-volcanic basins. Pulses are extensively but unevenly distributed. Of the cash crops, sugar has for many years been the mainstay, grown at times on almost all village paddy-lands from Cheribon eastwards, wherever permanent irrigation is possible. Sugar has become an integral part of village farming rather than of permanent European plantations (Fig. 76). Because religion, social custom, tradition and family life are all intimately tied into the ecology of indigenous farming, to make agricultural innovations is extremely difficult and extremely slow. To have established such an innovation as commercial sugar growing by smallholders and to have obtained exportable produce from them has been accepted as a mark of Dutch administrative success in Java. European plantations and indigenous farming systems go on simultaneously, but the latter were supplying an increasing share of the exports, reaching 40 per cent by 1938, and they are likely to form an even greater proportion in the future. Sugar for a time entirely displaced spices, the chief trading interest of the first Westerns in this region, as the key agricultural export. Here, as in other tropical areas, the huge and rapid production of the tropics quickly tends to saturate the market, so that sugar later

slumped heavily and lost much of its importance inside Java, where its acreage in 1940 was only 45 per cent that of 1930.

Though the island has had a significance in agricultural exports out of proportion to its size, subsistence agriculture is still dominant. In 1940, about 20 million acres were farmed for local foods and only 2.4 million acres for export crops, which, however, were valued at nearly three-quarters of all exports from the East Indies. Few commercial crops could be called exclusively European or exclusively Javanese, but rice, by far the largest single crop, is almost entirely produced by Javanese. Sugar, tea, cinchona and oil palm are mostly plantation grown, pepper comes generally from local farmers, while tapioca and coconuts are grown roughly equally by plantations and by smallholders. The Javanese have not taken up many rubber smallholdings and by 1937 practically all rubber from Java was plantation grown—a great contrast with conditions on the other islands and due to the preoccupation of farmers in Java with more immediately necessary food crops, whereas the other islands still had much virgin land awaiting development.

The staple food crops of Java are invariably irrigated and the cultivated landscape is extensively bunded, serving to prevent soil erosion and to conserve soil quanties. The torrential rains, loose topsoil and steep relief would otherwise cause quick erosion. The elaborate terracing of the loose ash on the sides of volcanic uplands is thus a soil conservation necessity as well as a device for water control and an expression of population density. Much ingenuity with limited means has been shown by Javanese farmers whose irrigation methods are of great antiquity but still very effective. Large modern irrigation systems have been built by the Dutch to cope with violent, erratic or entrenched streams beyond control by indigenous methods. Over 2¾ million acres were cultivated by these modern canal systems, the largest being on the Tjimanoek, Tjitaroem and Brantas rivers.

Patterns and Methods of Food Cultivation

Of about 20 million acres cultivated by local farmers in annual crops, 40 per cent is in wet paddy, 25 per cent in maize and 13 per cent in tropical root crops (yams and tapioca), the latter an association with the root agricultures common on Central Pacific islands.

So closely has wet paddy-growing become integrated with local farming that *sawah*, the Javanese word for it, is used to mean farming in general. A fluctuating total of about 4 million tons of rice is produced each normal year and eaten within the island. The amount of rice produced often reflects the general economic condition, so that greater profits in export crops cause less cultivation of rice. When sugar for export slumped over the period 1930-37, sugar land reverted to rice cultivation, whose total annual acreage over that period increased by 1.2 million to 9 million in Java alone. To this extent the agriculture of Java is more fluid, versatile and responsive than is the case with most countries of Southeast Asia, certainly more so than in other tropical sugar-growing regions. The average yield of rice (880 lbs. per acre) is higher than any other state in Southeast Asia, except Malaya, varying considerably within Java and being highest in the east.

While the greatest production of rice comes from wet lands, which are most abundant in the Cheribon and Pekalongan Residencies, one-sixth of the total paddy acreage is dry, a technique concentrated in the Jogjakarta, Bantam and South Buitenzorg areas. This older method yields less than two-thirds of the wet method and the increase of dry paddy over the last decade indicates considerable pressure on food crops and the full use already being made of irrigable land. Dry paddy farming exhausts soil far quicker than the wet method and it cannot be continued indefinitely on the same patch of land.

The methods of ploughing, planting and harvesting paddy in Java differ little from the hand methods of the rest of Southeast Asia. Most processing of the grain is also by hand, only a small proportion leaving any one locality to go to middlemen for mechanical milling by Chinese firms. For the heavy work of reaping, local labour is sufficient, the whole community participating if necessary and sometimes taking for the service a percentage of the harvest (varying from 10 per cent to 20 per cent). Essentially a cooperative communal activity in each village, Javanese rice farming still uses systems of common seedbeds and communal seedstores. Often the payment in kind for reaping services goes into a community pool.

Because of the double cropping and of the great variety of local conditions, the rhythm of activity is more spread than usual elsewhere. Rice seed begins to be sown in October for the West

Monsoon rains. Transplanting may be deferred until January or February. The harvest takes place 3½ to 6 months after transplanting. January is the peak sowing month for Java as a whole but some sowing goes on in parts of Java every month. Similarly the harvesting peak occurs in May and June, although harvesting takes place in one district or another throughout the year.

Tapioca has been occupying about one-tenth of Java's cultivated area and, besides being an important local supplementary food, it is exported (supplying three-quarters of the world's pre-war needs) for industrial starch, gums and textile sizes. The woody refuse after the starch has been extracted is used as cattle fodder.

About a quarter of the cultivated area is under maize, which is eaten in large quantities by the Javanese, and exported to nearby islands, in at least one of which (Timor) it is a staple food.

In 1949 Java and Madoera produced 6.1 million tons of paddy in the ear from wet lands and .5 million tons from dry lands, a total of 4.2 million tons of clean rice. While in total this production (80 kgms. per person) is barely adequate for direct consumption by the Javanese, who ate 86 kgms. per person each year over 1936-40, there is an export of finer grades to Sumatra, Celebes and Borneo and an import of poorer qualities from Siam.

The post-war position has been confused by dual controls and disrupted transport, yet in 1947 the Dutch controlled *sawah* were only 9 per cent below prewar acreages and the price of rice was the lowest in Southeast Asia. By 1950 paddy was being sown on 9·5 million acres.

Cultivation for Export

Sugar occupied about 650,000 acres of Java-Madoera in 1931, dropped to 65,000 acres by 1935 and was back to nearly a quarter of a million by 1940. This great fluctuation in acreage and of labour demand resulted from external prices and the varying impact of international control. It missed causing a rural catastrophe in Java only because of the method of farming. Sugar is essentially a crop of the wet lowlands, of land suitable for rice. A three-year rotation system is normally used by which the planters, generally European, rent acreage for sugar from local farmers, who do the cultivating and harvesting for the planter at wages and between-times cultivate the rest of their land in the usual subsistence food crops. Thus in years of bad external sugar

prices it is not a matter of sugar lands going out of cultivation, but of the land being put to the other uses by the local farmer. Radically different from conditions in the West Indies, this is a relic of last century's "Culture System" of forced cultivation for the government, a system which, whatever its social effects, successfully produced large quantities of sugar, then the mainstay of exports. Sugar is a long-term crop compared with most of those in Java: it is planted between April and October under the planter's supervision for harvesting after twelve months. The heavy demand for labour at cutting time is readily met because the plantation is invariably in densely populated lowlands; altogether about 60,000 temporary wage earners were used for sugar plantations in 1940. Across the sugar-growing lowlands, light railways have been built to bring the cane to the mills, whose number varies with the acreage cultivated. Before 1929, Java had 179 sugar factories, three-quarters of which had closed down by 1940.

While sugar was typically produced by Dutch planters in Java, the export was primarily to Britain and India, owing to the expansion of a protected beet-sugar industry in Holland. Javanese farmers also cultivated some sugar on their own account, obtaining lower grade sugars for local consumption and not using the mills owned by the large planters. Local cultivation of sugar was a steadily expanding business and Javanese consumption was rising. The smallholder may ultimately set the character of this industry, much as rubber smallholders tend to do elsewhere.

Over the inter-war years, Javanese sugar production has undergone changes no less than the acreage involved. It dropped from 2.9 million tons in 1930 to less than half a million tons in 1936, and rose to 1.4 million tons by 1939 when India alone was taking about half a million tons from Java. It was evident in the pre-war years that, from being a producer of food products for Europe, Java was becoming a producer for the countries of Asia, a tendency which may become more apparent in the post-war period. For 1949 the exports of sugar from Java were negligible compared with those of 1938, evidence of stagnation and destruction which may take so long to rectify that rival tropical producers may eliminate any need for Java's sugar (295,000 tons in 1949).

Coffee and tea have at different times been the incentive to planters for export from Java. Coffee became highly speculative and proved very susceptible to devastating disease, besides quickly

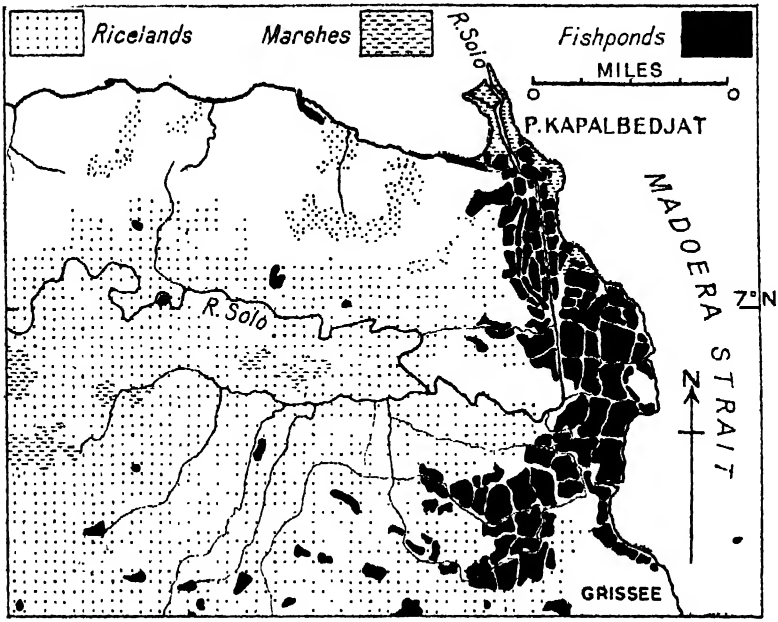

FIG. 77.—Land Utilisation at the Mouth of the Solo River

exhausting the soil, so that, although it was forcibly cultivated under the Culture System last century, it is now only a minor crop produced in conjunction with others. Tea, begun as a British plantation interest in Java, particularly in the cool, rainy Preanger Highlands, because the tea bush is limited to areas whose driest month has not less than 20 rainy days, has to a great extent displaced the older Dutch coffee trade. Some 85,000 lbs. of tea were being produced annually before the war, local smallholders supplying about 15 per cent which they sold green to the planters for processing. The 1950 tea crop in Java was estimated at 30,000 tons, but only 23 tea factories were operating as against 243 before the war. Individual tea factories may not be re-established and cooperative processing may become the normal. A change of direction in exports has appeared; instead of two-thirds of the Java tea going to U.K. and U.S.A., over half the 1949 output went to other Southeast Asia territories. A fairly substantial smallholder production of tobacco goes on in the *sawah* lands of the eastern valleys.

Cinchona, whose bark is the basis of quinine, has had a varied

success. Nearly stifled commercially by a monopolistic buying ring late last century, cinchona has since been an expanding, specialised industry based on trees which grow at elevations between 3,000 and 6,500 ft. on the Pengalengan Plateau near Bandoeng. Over 32,000 acres, largely estates, were still cultivating cinchona in 1948, estimated to produce about 500 tons of quinine.

Commercial cultivation of spices in Java is largely dead. The local demand for cloves, for example, is more cheaply met by importing from Zanzibar, a great change from the early Dutch period when spices were the basis of Javanese exports. Indigo cultivation, at one time an objective of Dutch agricultural policy, no longer goes on and synthetic indigo is imported for Javanese textiles. The coconut has, on the other hand, assumed major significance as a cash crop. Coconuts are grown very largely by Javanese smallholders whose total planted area in 1939 was about a quarter million acres.

Rubber continues to be much more exclusively a plantation industry in Java than in Sumatra; the plantations are invariably located round the 1,500 ft. level. Being heavily capitalised, in time of low prices Javanese rubber has difficulty in competing with the smallholder production in other parts of the Indies and with crops in other parts of Java. Plantations were occupying 1.4 million acres of Java and Madoera, of which area 41 per cent was in rubber, 19 per cent in tea and 17 per cent in coffee. Java's production of rubber declined from over 90,000 tons in 1937 to 72,500 tons in 1950, of which over 80 per cent was from estates.

Because cattle are necessary as draught animals for fields and local transport, they are reared for this purpose and serve as peasant investments as well. Over 5½ million cattle (40 per cent buffaloes) were distributed rather unevenly over Java and Madoera. This represented a cattle density of over 100 per square mile in Java and over 300 per square mile in Madoera where some districts had a density equalling that of European cattle-breeding regions. Buffaloes are preferred in the damper, cloudier west where rough haulage has to be done, while oxen are more numerous in the rice areas of the east. Cattle breeding is a widespread minor occupation and in Bantam and Preanger large herds are kept. Madoera is a major centre of the cattle trade, exporting over 90,000 annually for meat as well as large numbers for draught in the nearby islands.

Industrialisation

As a development of this century, a considerable amount of industrialisation has proved possible by extending the domestic industries already existing and by village industries of a type developed in Japan. While the production of these industries was small relative to the numbers of part-time workers employed, it added up to a considerable total, which went into local consumption, though only *batik* cloth, cigarettes and hats had a wide circulation. European-style factories employed farm labourers at off-seasons to process sugar, rice and tapioca or to weave imported cotton. Rubber manufacturing and chemical industries had been established as part of Dutch policy. In Madoera large-scale salt extraction developed to take advantage of the high evaporation rate and the large domestic market in Java.

Extractive industries of Western pattern were based on the manganese ores of Jogjakarta and Preanger, on sulphur from various craters (as at Kawah Poetih), on iodine springs at Soerabaya and on the china clay of Preanger. Monthly about 5,500 tons of petroleum were produced in 1948 in Rembang and Soerabaya and the oil refining went on at Tjepoe Wonokromo and Kapoean (Blora) for the Java market. Mineral production was, however, a very minor part of Java's activities.

The Culture System

The Culture System which strongly influenced the form of agriculture in Java was operated by the Dutch after the Dutch East India Company failed by other means to obtain a substantial export of agricultural products. Introduced in 1830 and withdrawn in 1870, this system, an unusual one for colonial territories, compelled Javanese farmers to give a part of their land and their labour for cultivating, under Dutch supervision, prescribed export crops (sugar, coffee, indigo) to be sold in Europe for the benefit of the Dutch Government. By thus treating Java for a period as a money-making concern, the Dutch Government soon obtained a huge revenue surplus, for the first time in Java's colonial history. More important in the long run, the system incidentally taught the Javanese new types of intensive cultivation and an understanding of the principles, new to Java, of large-scale agriculture for export. It proved a very heavy tax on the

fertility of soils and on the families which had to provide labour, to the extent of impeding subsistence farming, so that the Culture System offended the spirit of the times and was soon resented in Europe no less than in Java. Although at maximum it only affected five per cent of Java's cultivated area, it led to new cash crops, and planters (for sugar especially) continued to cultivate on lines established by the Culture System long after it had been abolished. Coffee, sugar and indigo, the objectives of Dutch policy, soon faced depressions due to rival producers in Europe (beet sugar) and elsewhere in the tropics, so that an increasingly diversified and highly scientific type of planting had to be adopted.

One of the reasons for imposing the Culture System had been the Javanese tradition that the village or tribe has land rights as a community, a tradition admirably suiting the interests of self-contained communities but not of exporters. Hereditary personal possession of land is gradually displacing the periodical redistribution of communal land, an old tradition persisting over large areas. While in 1882 only 18 per cent of villages followed the personal property land system, 39 per cent did so in 1927 and the rest redistributed land at various intervals. One effect of the Culture System was to establish among Javanese the idea that personal land owning is a heavy burden. The regular subdivision of agricultural land by sharing among the huge rural population has produced very small farms and the average farm rapidly diminished in size as the population increased. In 1930 the average holding of wet and dry land together was 2.45 acres, decreasing to 2.2 acres in 1937. So closely is farming and subsistence integrated with social and religious life that only in very recent years, as a long term effect of the introduction of money crops, has there been much sign of Javanese farmland falling into the hands of absentee mortgagors.

Population Patterns

One of the most densely populated countries of the world, Java averages over 800 people per square mile and by 1947 totalled 53 million inhabitants (Fig. 78). Within the island many localities have even greater congestions. In the states of Soerakarta and Jogjakarta, over 3,000 people live on each square mile; these very dense regions are directly associated with wet paddy which occupies more than 40 per cent of their surface. Southern

Bantam and the southeast corner of Besoeki, which are dry or infertile areas, show on the population map a density averaging less than 350 persons per square mile.

The reasons for this concentration of people are complicated and manifold. No one reason is significant on its own. Propitious climate, constantly rejuvenated basic volcanic soils and extensive irrigable lowlands suiting rice, provide the physical basis. Long association with western methods and interests has led to a remarkable interlocking of subsistence and cash crops, combining oriental and western techniques which have here achieved some sort of balance. Java has had an exceptionally prolonged period of social security coupled with the increasing communal assurances of major irrigation and drainage systems. The Culture System, short-lived though it was, proved to be an incentive to population increase, because it placed on the community a pressure to obtain extra hands, so that towards the end of the Culture System period population was increasing at the fantastic rate of 33 per cent per decade.

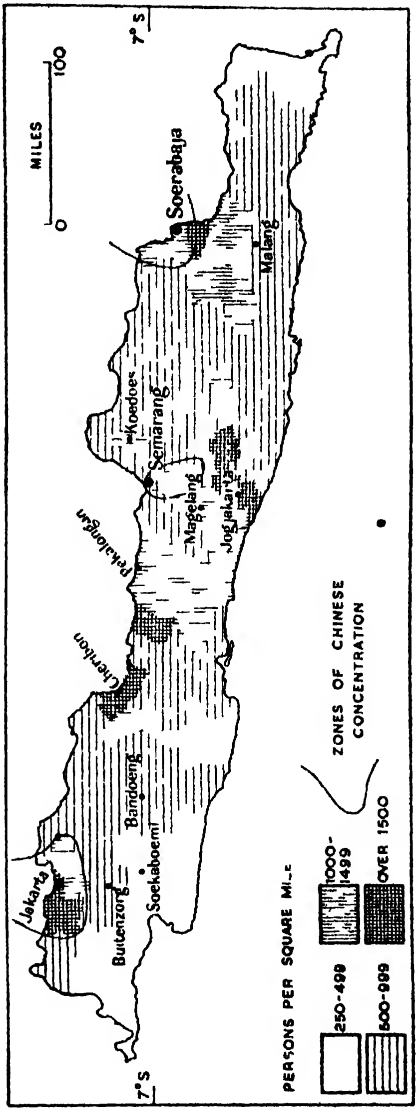

FIG. 78.—The Distribution of People in Java

The population concentrates in three zones:

1. Throughout the northern alluvial plain, from the Jakarta

Plain through to the plains of Probolinggo and Pasoeroean, dense populations have grown up in association with the wet paddylands and sugar cultivation. In this belt are Adiwerno (near Tegal), a district with 6,200 persons to the square mile, the highest rural density anywhere in Java; and also the chief exits of the export trade, Jakarta (over 900,000 people), Cheribon, Semarang and Sourabaya. Jakarta, the original base for Dutch influence in the archipelago, now lies too far inland for modern shipping which is handled at its outport, Tandjong Priok. Together, these four ports handle about three-quarters of all shipping tonnage connected with Java, which has a heavy coastwise traffic as well as overseas movements.

2. Within the intra-volcanic basins of Central Java (the Solo, Madioen, and Brantas basins) lives about a third of the Javanese people, occupied almost entirely in agriculture, the urban centres of Jogjakarta and Soerakarta (each over 120,000 people) containing only a negligible proportion of the people. Despite the frequency of eruptions causing heavy losses of life and property, the volcanoes are ringed by crowded villages and farms pressing up the slopes to the newer ash deposits.
3. Subsidiary concentrations of people are in the Bandoeng-Garoet Basins, connected with plantation agriculture on western lines. On the south coast the only densely populated zone is between Kali Serajoe and Kali Progo, where a narrow belt of deltaic alluvials from the Central Java volcanoes permits a rural life resembling that of the northern alluvial plains and extending southwards the high densities common to the intra-volcanic basins. Tjilitjap, the only fairly deep-watered harbour on the South Coast and sheltered from the violence of Indian Ocean storms by the Noesa Kambangan, is an outlet for the southern portion of densely-populated Central Java. Its trade is overwhelmingly export, mainly sugar and tapioca.
4. Although the relief of Madoera consists predominantly of dry limestone, its few coastal plains are highly productive, and it sustains an average density of 1,300 per square mile, which is higher than the average for all Java. The medial trough is barren and thinly peopled, but elsewhere rice, maize and tobacco-growing, cattle-rearing and salt production are important activities. From Madoera there is steady migration into Java to relieve the pressure of population.

These zones of concentrated population and agricultural activity are linked by a close net of roads and railways threading the northern plain from end to end, with offshoots southwards into the fertile intra-volcanic basins and to the Tjilitjap and Jogjakarta zones. Only a few patches of Java on the South Coast and on the more broken mountains are over ten miles from a road or railway, which combines with the ample coastwise shipping to give Java an excellent transport system.

In Java settlement forms resemble those elsewhere in Southeast Asia. River and canal bank settlements in lines occur upon all the rice-growing plains. Along both north and south coasts are linear sand-dune and sandspit settlements, with further linear settlement on the old marine terraces. Girdles of villages surround the cones of basic volcanoes. Defensive stockades to settlements are practically non-existent owing to the centuries of policing; cattle pens are unusual on the village landscape except in the breeding areas of Madoera. Javanese houses are bamboo and thatch structures without stilts, differing in this respect from the typical Malay-Burmese house forms.

Javanese Peoples

The people of Java are more homogeneous than those of neighbouring territories. Only three main languages are used, permitting the diffusion of literary, musical and plastic arts which over centuries have reached and maintained very high standards and continue to play an intimate part in Indonesian social and cultural life. Justifiable pride in this culture, modified to some extent by Islamic influence, is the basis of Javanese nationalism, to which the communal system adds the preference for the communal solution of difficulties, and which expresses at the same time the urgencies arising from a teeming population in a territory now reaching the limits of its capacity to support people.

There are distinctions between the Javanese, the most numerous group, whose homeland is the eastern two-thirds of the island, the Sundanese of the west, and the Madoerese, who spread into Java from their own congested island. Among Javanese, the Hindu and Buddhist influence of the first millennium Indian colonisation period, whose stone monuments are at Borobodur, Blitar and Kedoes, expresses itself in many ways, not least as the aristocratic tradition and as the self-contained community of the *desa* or

village. Upon these smouldering traditions is imposed the different communalism of Islam. Sundanese people speak another language and show their cheerier outlook by using brighter coloured clothes. Their villages are characteristically broken into small hamlets and their cultural development is not considered to have reached Javanese standards. The Madoerese are dour, dogged and more individualist than the Javanese, befitting their function as the chief cattlemen of Southeast Asia and their origins on an island where it is a struggle to survive.

Though the population is extremely dense, it has led to only a trickle of migration from Java to the other islands, despite the increasing difficulties of living in Java. Pressure of population has been met so far by increasing the intensity of agricultural production, by pushing cultivation to the maximum within Java, and by industrialisation.

Immigrants

While Java has itself a great indigenous population, more than 500,000 Chinese have settled there, their presence dating from the very early days of Dutch colonial activity, when local labour could not be detached from its own ecology and Chinese were brought in for sugar plantation work. Since then Chinese have become the key community of urban middlemen and shopkeepers and they play a large part in inter-island commodity trade. One-third of Java's Chinese live in Jakarta, Semarang and Soerabaya, indicating their association with external trade. Most of the Chinese retain associations with China, to which they expect eventually to return. In addition, about 50,000 Arabs, mainly Hadramautis, live in Java, engaged also as middlemen, but tending to merge with the Javanese by marriage. They are highly respected for religious reasons as evidence the religious traffic and pilgrimages between Java and Arabia.

Unique in Southeast Asia colonial developments was the settlement on Java of nearly 200,000 Dutch people. Until 1870, only Dutch officials lived there, but from then onwards permanent migration of Dutch people steadily increased until 1940. The Dutch chiefly settled in Jakarta, Buitenzorg and Bandoeng, working as officials, traders, professional men and primary producers. This group was the one chiefly affected by post-war events, which almost eliminated it.

Java escaped most of the effects of large-scale immigration of temporary foreign labourers and its cultural landscape has retained the character of a mature indigenous life well adjusted to and traditionally corporate with its environment. Having multiplied ten times since 1815, the people of Java were obliged to pioneer in quite a different manner from those of Malaya and Burma—by developing an extended, intensified and diversified farming combining both subsistence and cash farming practices.

Chapter Fifteen

THE EAST INDIES

THE WESTERN ARCHIPELAGO : BORNEO

LARGEST of the Sunda Platform land units, Borneo takes its name from Brunei, the now diminutive west coast sultanate which once controlled most of the island. It bestrides the Equator and is predominantly covered with Tropical Rain Forest, merging at altitudes to great stretches of Mountain Moss Forest and in the coastal lowlands to Freshwater Swamp Forest and Mangrove (Fig. 79). Flanked to west and south by shallow seas scarcely 200 ft. deep, Borneo has only a narrow continental platform to north and east where the sea floor slopes steeply to great depths of the order 12,000 ft.

BORNEO : AVERAGE RAINFALLS (in inches)

	Rain days (*over* .02in.)	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Sandakan (105 ft.)	—	18.2	10.4	7.9	4.1	5.8	7.4	6.4	7.9	9.5	9.8	14.8	17.4	119.6
Pontianak (10 ft.)	182	10.6	8.5	9.6	11.1	10.7	8.9	6.5	8.6	8.6	14.7	16.1	13.1	127.0
Balikpapan (16 ft.)	137	7.7	7.5	9.0	7.6	8.7	8.3	7.8	6.9	4.8	5.7	6.4	7.5	87.9

Divided for most of a century into a smaller north-western portion under British influence (North Borneo, Brunei and Sarawak) and a larger Indonesian portion to south and east, the island has shared little in the innovations and advancements of adjoining territories. This backwardness is no recent thing, though there is evidence of very old Chinese interest in NW. Borneo (for pearls and bird's nests) and of some first millennium Hindu penetration along South Borneo rivers. Borneo exemplifies today conditions which four or five centuries ago were probably widespread in the archipelago and nearby territories. That they persist in Borneo is due (*a*) to being off the track of Southeast Asia routes; (*b*) to low fertility of its surface and the low sunshine of its climate; (*c*) to the non-discovery of any valuable mineral to attract a "rush" deep

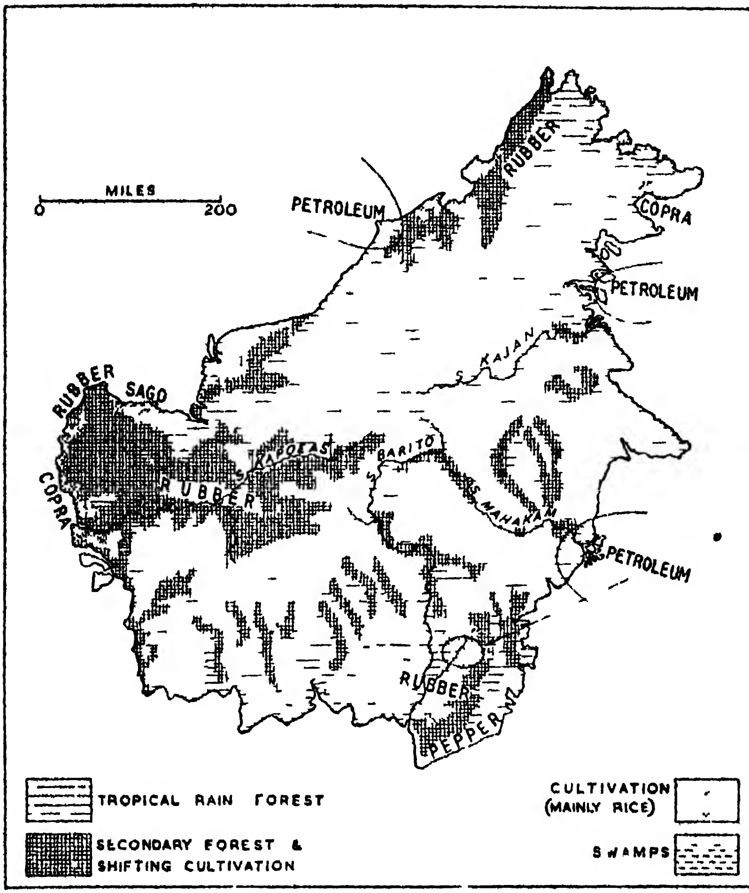

FIG. 79.—Land Use in Borneo

into Borneo; (*d*) to the compactness of the island; (*e*) to the difficulty of approach by Borneo rivers which invariably have shifting bars across their mouths so that even shallow boats can only cross at highwater or, on the east, dangerous barriers of coral reef, and (*f*) to the absence of any strong agricultural tradition among the people.

Over the interior of Borneo moves a scattering of aboriginal peoples, many of whom have not advanced beyond the collecting-hunting stage, and where they practise agriculture it is by the shifting system. Activity and settlement are peripheral (Fig. 80) and the interests centrifugal; even on the coasts the cultural

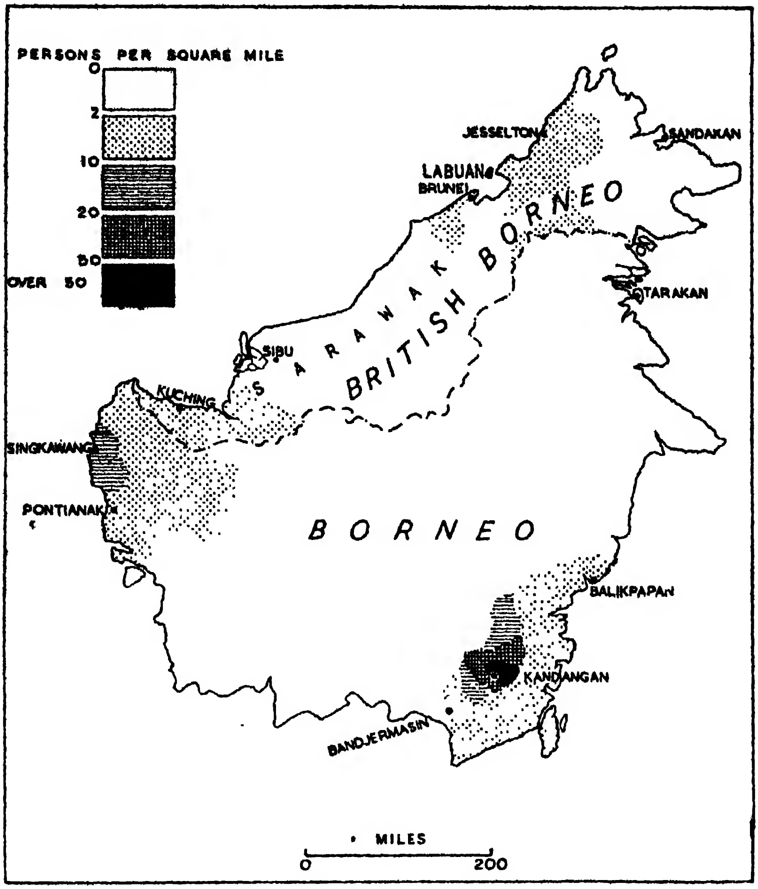

FIG. 80.—The Distribution of People in Borneo

landscape is that of crude tropical pioneering settlements poor-looking and squalid, mostly peopled by immigrant Chinese and Malays from nearby territories. To the people of the interior applies the collective name "Dyaks" although they are subdivided into many groups at widely different cultural levels (Fig. 81). On the coast, settlements are often like lake dwellings built out over shallow tidal waters. There is practically no transport except on the rivers or by jungle paths. Of 2¾ million people now in Borneo, only about a quarter are in the British sector.

The landform, hilly rather than mountainous, and generally below 6,000 ft., is one of advanced maturity, varying from the

rounded slopes of igneous rocks to the flat-topped interfluves of sandstone country, as in the Madi Plateau, and the striking fretted landscape of limestones, as in the Boelit Valleys, which are covered with vegetation because their porosity is offset by the even and heavy rains. The mountain systems reflect structural lines deriving from old E-W. fold-fault systems with some NNE-SSW. trend lines evident in the long watershed boundary of Inner Sarawak. Round the river mouths spread great swamps upon which the distributaries are constantly dividing and reforming.

British Borneo

Under this term can be included Sarawak, Brunei and British North Borneo, an area of about 80,000 sq. miles, of which 60 per cent is in *Sarawak*, draining mostly by streams to the west and north. The Rejang is the longest river but its great deltaic swamps form an impediment to penetration along it, though Sibu, 60 miles from its mouth, ranks as a port for the 125,000 local people of the Rejang Valley. About three-quarters of a million people inhabit British Borneo altogether: of these half a million are in Sarawak, mostly close to the southern and northern coastal sections, dominated by Chinese immigrants who act as middlemen and exporters for local produce and as artisans on the oil fields. Kuching, the capital, is a minor port in Datoek Bay, well away from deltaic obstructions which indicate the rapid sedimentation going on at the coast. Miri, close to Brunei, developed over recent years as oil producer, with refineries at Lutong, which turned out 3½ million tons in 1949; these wells were destroyed in 1941 but are now coming back into production. At Lutong ends a pipeline from Seria in Brunei, where over 3·5 million tons of crude oil were being obtained to swell Lutong's refining output (1950).

British North Borneo contains about 380,000 people, mostly Muslim seafarers scattered round the coasts. Its chief towns, Jesselton and Sandakan, include many Chinese immigrants.

Brunei, while only a small unit, has continued to be predominantly Malay.

This large territory of British Borneo was never agriculturally self-sufficient. Brunei produces only a third of its rice needs and North Borneo about half. Chief interest has centred on rubber and coconuts to take advantage of the cheap land, although labour has been a major difficulty. British Borneo last century attempted

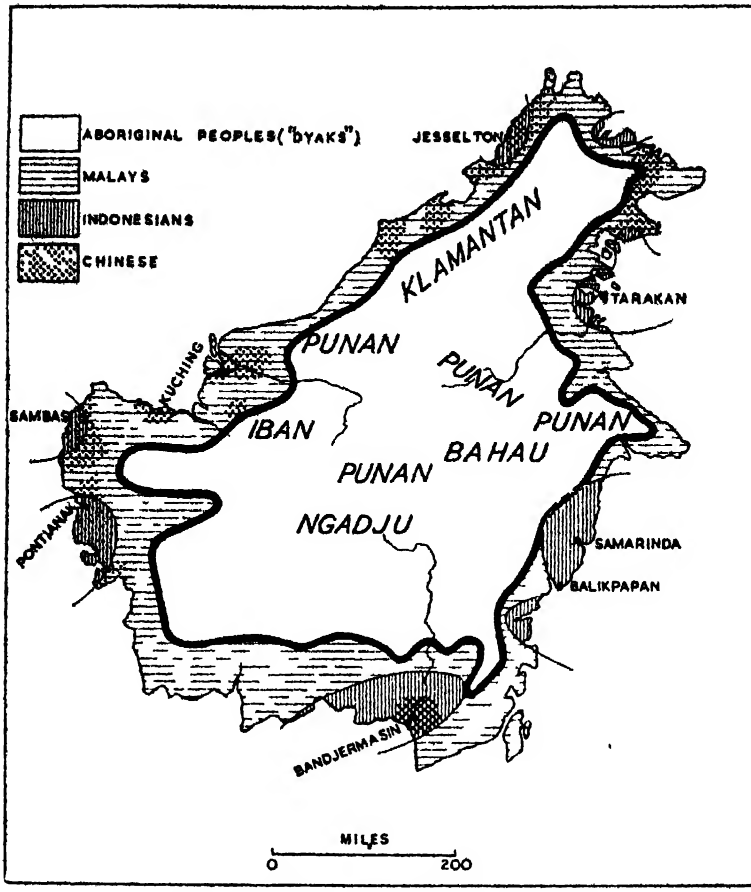

FIG. 81.—Ethnic Distributions in Borneo

commercial tobacco growing and failed; rubber is now its mainstay, accounting for 70 per cent of the exports and totalling 60,000 tons in 1949. While large company plantations had been started, smallholdings represented an expanding interest, worked in conjunction with rice cultivation. For these pioneer areas, statistics are not detailed. Some 160,000 acres altogether were in rubber, mostly in North Borneo, which was also the leading copra producer. Rice occupies a total of 797,000 acres (1950) in small poorly-kept patches, but official postwar development schemes plan to create new rice-growing areas in these territories on the basis of imported Chinese labourers, with the object of relieving

rice shortages in Malaya and British Borneo. Sarawak was always a key sago producer, containing about 80 per cent of British Borneo's 96,000 acres under sago.

Much pioneer settlement in British Borneo was destroyed by military action during the war. The flimsy structures burned quickly and the already precarious economy collapsed. Only the oil wells show signs of speedy rehabilitation, reaching an outpu of 3.5 million tons in 1950, which was 3½ times the prewar output.

Indonesian Borneo

The greater area and coast of Indonesian Borneo are responsible for its higher population (over two millions) which does not indicate any development more intensive than that in British Borneo. The population has a slightly different composition on the coast, where there are Bugis from Celebes in the southeast, Javanese in the south, and Chinese in their very old settlements at Sambas (where their colony is about 1,000 years old) and Pontianak in the west. Local people who are Muslim are all described as Malays, a term which covers many different types; the others, generally called Dyaks, are tribes of Kajan, Kenja and Bahau in Central Borneo, Ulu, Ngaju in the south and east, together with many nomadic tribes such as the Punan. Among Dyaks strong family ties have replaced the more usual village systems and often the whole of a large family lives in a single "long house," located on ridges and containing what is almost a village of related people.

Only the valleys of the west and southeast are well peopled, and all five towns, Bandjermasin, Pontianak, Balikpapan, Tarakan and Tandjoengseilor are coastal, containing about 10,000 people each. Round Sambas and Pontianak much land is under coconut, rubber and pepper; the middle Kapoeas Valley is fairly well cultivated with similar crops round Sintang whence the products go by river to Pontianak. In the southern lowlands between Soengei Barito and the Meratoes-gebergte is a well-populated farming area less rainy than elsewhere and less severely leached, so that rice, pepper, rubber and coconuts are grown for export by way of the local town Kandangan which several good roads link to Bandjermasin (16,000 people), the chief town of Indonesian Borneo.

The East Coast is everywhere thinly peopled. Coal was mined prewar at Poelau Laoet, but the greatest postwar exploitation has

been at Loa Koeloe and Parapattan which yielded 135,000 tons in 1948. Balikpapan was focus of the lower Mahakan Basin where Samarinda, one of the largest oilfields in the archipelago, and an outlying oil zone at Tarakan, were producing 12½ million barrels of oil in 1940 for refining mostly at Balikpapan: production for 1950 was running at about 70,000 tons monthly. Food cultivation is negligible except where Javanese have settled. Pepper for export is grown on Poelau Laoet. Smallholdings of rubber were becoming popular and produced at the rate of 10,000 tons per month by 1950.

Chapter Sixteen

THE EAST INDIES

THE EASTERN ARCHIPELAGO

EAST of Borneo and Java, the population of the islands thins out and development is both recent and not far advanced, so that geographical references diminish almost to those of a gazetteer. These islands are mostly volcanic, set in very deep seas. Coral reefs invariably surround them, often as double palisades preventing access from the sea. The maze of small islands, often ill-surveyed and scarcely above water, presents a worrying obstacle to navigation. Today the strait between Bali and Lombok is the most frequented international shipping highway through the region yet the Portuguese in their decline as Far Eastern traders for a time used the Macassar Strait as route to and from China, and Macassar as a watering place on their way to the Moluccas. Halmahera, which so curiously resembles Celebes in form, and its offshore islands, the Moluccas, were the magnet for spice traders through the Roman and medieval periods, because they produced unrivalled cloves. That interest has disappeared and there is no commercial activity drawn towards these smaller eastern islands, apart from minor copra production which has varied much in prosperity, tending now to be formally and reliably cultivated on plantations farther west rather than in small patches among these islands, where the collection costs are high and the copra standards uncertain. Celebes, Bali and Lombok today merit interest since upon them live 7 million of the approximate 8 million people settled in this eastern island region, which has become the separate political unit called East Indonesia since 1946; thus the new political pattern emphasises the "mediterranean" section of the Indies.

The southern part of the Macassar Strait was a most difficult sea passage for sailing ships and is still considered dangerous to shipping in stormy seasons. Innumerable coral-girt islands and reefs lie across it, forming in one place the Great Sunda Barrier

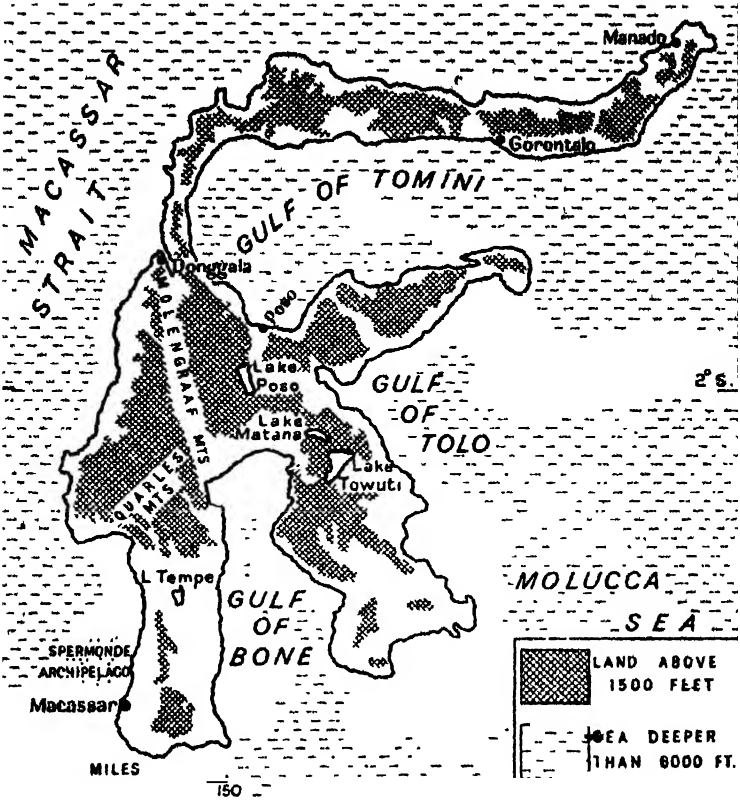

Fig. 82.—Celebes

Reef, only slightly smaller and more dangerously located than the comparable Great Barrier Reef at Queensland; it thrusts nearly 250 miles out from the Borneo coast, leaving a narrow gap of deep water between it and Celebes. The Reef extends southward irregularly, to the Lima and Kangean Islands, making a shallow coral-edged bank over 50,000 square miles in area (Fig. 7). Other coral masses are scattered between this bank and South Celebes, of which the Spermonde Archipelago off Macassar is the largest.

Celebes

Though larger than Java, the tentacled island of Celebes (Fig. 82) is remarkably attenuated and digitated, its 3,000 miles of coast enclosing 73,000 square miles, so that no part of Celebes is

more than 70 miles from the sea. This does not make for greater accessibility because rocks and corals line the coast almost without break, probably explaining why the island escaped the flood of early Indian colonisation, was largely bypassed by early European traders and became Islamised at a later date than most parts of the East Indies.

An extension of that arcuate series of folds and faults already observed in Sumatra and Java, Celebes has been subject to tectonic stresses from many directions; its shape relates to the Java-Sumatra mountain system on latitudinal lines and the Philippines system on meridional lines. Its precipitous shores and the uplifted blocks and rift valleys which form its surface evidence the strong influence of faulting processes which at a later stage involved vulcanism, still apparent in the extreme northeast tip behind Minahasa and in the extinct Lompobatang of the south. All except its northern limb lies below the Equator but the whole island has the typical humid, warm unvarying climate which permits Tropical Rain Forest over its whole surface.

THE EASTERN ARCHIPELAGO: AVERAGE RAINFALL (inches)

	Rain days (over .02 in)	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Manado (30 ft.)	164	17.7	15.1	11.6	7.9	6.3	6.5	4.6	3 7	3 4	4.6	8.7	14.4	104.5
Macassar (13 ft.)	134	26 6	23.2	16.4	6.0	3.4	2.9	1.4	0.4	0 6	1.7	7 2	23.5	113.3
Koepang (148 ft)	80	15 2	15 8	8.5	2.6	1.1	0.4	0.2	0.1	0.1	0.7	3.6	9.5	57.8

The rivers deriving from this setting are large in volume, but at a very youthful erosional stage; their short courses are frequently broken, in places with great waterfalls, elsewhere by deep incisions and gorges. Very little of its surface is below 1,500 ft. and Celebes ranks as a most mountainous terrain, the only significant lowlands being the Sidenreng-Tempe lake belt which almost isolates the southwest limb, and the valley of Sampara at the southeast tip. Lakes are numerous, particularly towards the middle of the island, and in some cases are graben lakes of great depth; Lake Poso, one of a group of lakes on NNW-SSE. lines, has a depth of nearly 5,000 ft. Other lakes have filled up to form inland marshy flats.

While gold, nickel, iron and petroleum have been traced in Celebes, they have not been worked to any extent.

On Celebes there are nearly 5 million people, of whom over a

million are in Minahasa. Large tracts of the country are still unpopulated except by a few wild tribes. The Minahasa district has a density of 75 persons per square mile, whereas Macassar on the southwestern limb has as many as 325 per square mile. Dense settlement is confined to the coast, and the interior has only a wandering population in the isolated valleys and basins. Most numerous of the indigenous people are the Bugis and Macassaris, 2 million of whom live in the southwest. They were historically one of the most active Muslim seafaring peoples of the Indies, acquiring a notoriety as pirates and slavers; they now rank as an inter-island trading people whose little sailing ships may be found anywhere between Singapore and Port Moresby. The Portuguese recruited Bugis to work in Malaya, a very early sign of colonial labour shortages there, and a colony of them settled inland from Malacca. Tribes of the interior are collectively known as Toradjas whose animism has distinct Polynesian associations; they practise the shifting cultivation of yams. In the northern Celebes limb are Muslim Gorontales and Christian Minahasis which latter are thought to resemble Filipinos and to be the most progressive and advanced people in Celebes—probably because they are well educated on western lines and European mannered.

The concentration of people in the northeastern tip, Minahasa, results largely from the more intensive agriculture made possible by young volcanic soils. Only a valley agriculture is practised there and none of the volcanoes of this corner are terraced to the maximum as in Java. The narrow fertile lowlands are vigorously farmed, centring on subsistence rice with coconuts and maize for export from Manado (population 27,000). In the southwestern peninsula too, large populations are supported on volcanic ash soils from Lompobatang, which are cultivated for rice, maize, coffee and coconuts. On the west coast of this limb, Macassar (population 85,000) acts as outlet to the belt of dense population which extends along the coast to the low-lying area round the Sidenreng-Tempe lakes, through which zone, and radiating from Macassar, has been built the only noteworthy road system of Celebes. Westernised farming styles and plantations are negligible in Celebes and the exports derive from smallholders. Rubber has not been taken up to any appreciable extent.

That Macassar is so central to seaways among the easternmost islands causes it to be named capital to East Indonesia in the

projected new federal structure of the Indies, to revive a pattern evident, in the later Portuguese period among the lands.

Bali and Lombok

The islands stringing from Bali to Timor are known as the Lesser Sunda Islands, of which only Bali and Lombok are densely populated and well studied. They are thus interesting geographically while by no means representative of conditions in the islands east of them. Separated by the Lombok Strait, the safest and deepest channel through the western Lesser Sundas, the physiography and patterns of Bali and Lombok have close similarities. They are to be considered as extensions of the relief forms already met in Java. Thus the southern parts of both Bali and Lombok are low limestone plateaux, as in South Java; the outcrop in Bali is small, forming the bare, unpeopled Tafelhoek, which is linked to the island by a tombola or sandspit, but Lombok has a large out-crop forming a waterless karst upland (about 1,000 ft. high) thicketed with bamboos, barren and unpeopled, with a similar limestone outlier in the sterile zone between Djembrana and Tabanan (Fig. 83).

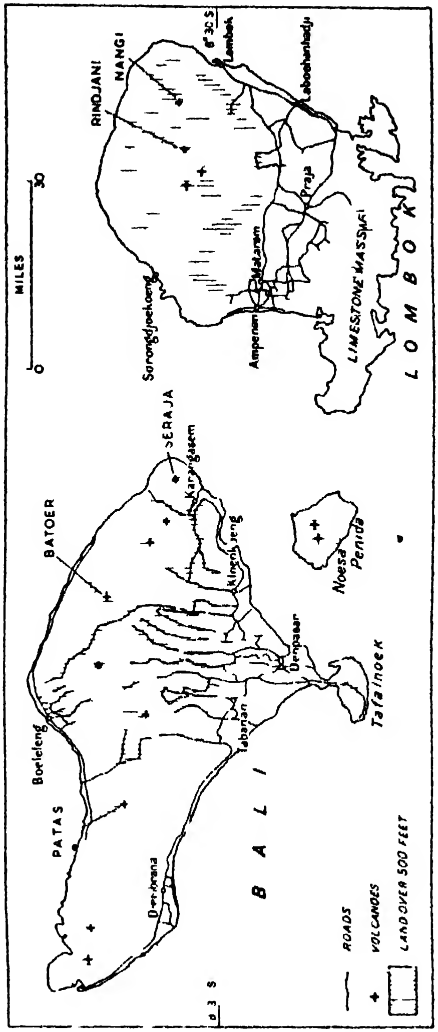

Fig 83—Landforms in Bali and Lombok

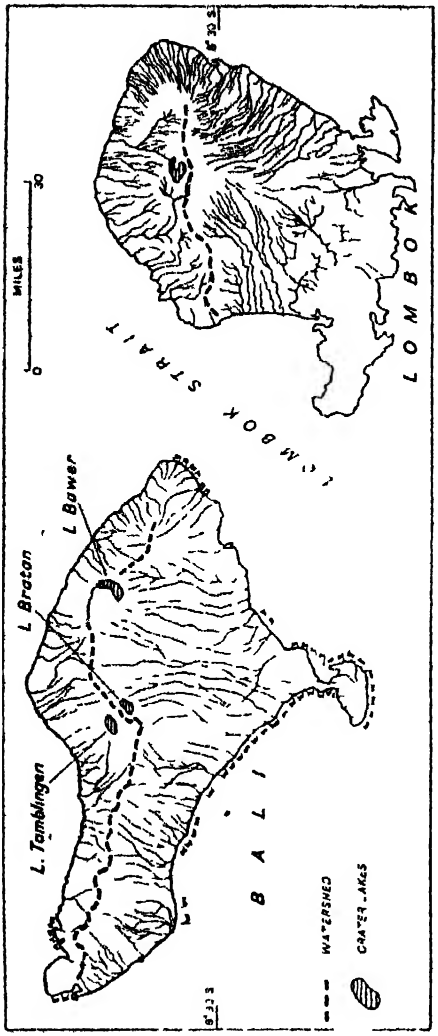

FIG. 84.—Drainage Patterns in Bali and Lombok

While the substructure of Bali and Lombok to the north is undoubtedly an extension of the fold-faulted sedimentary ranges of the Java axis, it is completely obliterated by volcanoes whose ejecta dominate both landscapes.

In Bali there is a line of active volcanoes well to the north (Piek van Tabanan, Tjatoer, Batoer and Agoeng) scored on their northern sides by short streams too torrential for irrigation and dry for half the year. Large streams fan southward (Fig. 84) to build up a most fertile inclined alluvial plain, constantly rejuvenated by water-borne volcanic ash upon which dense settlement and paddyfields on ingeniously irrigated pre-Dutch terraces extend inland and upward to about 2,000 ft., slightly thinning thereafter, although settlement and cultivation extend up to the western rim of the Batoer caldera at about 5,000 ft. Rivers on this side are incised in the loose, high-level ash; they vary greatly in volume because the watertable in the scoria quickly lowers during dry seasons. These streams are in torrential spate during the rains and almost dry up during the east monsoon (May to November). Upon this sunny tilted plain the fertility of the transported ash soils exceeds even that of Java and the population density

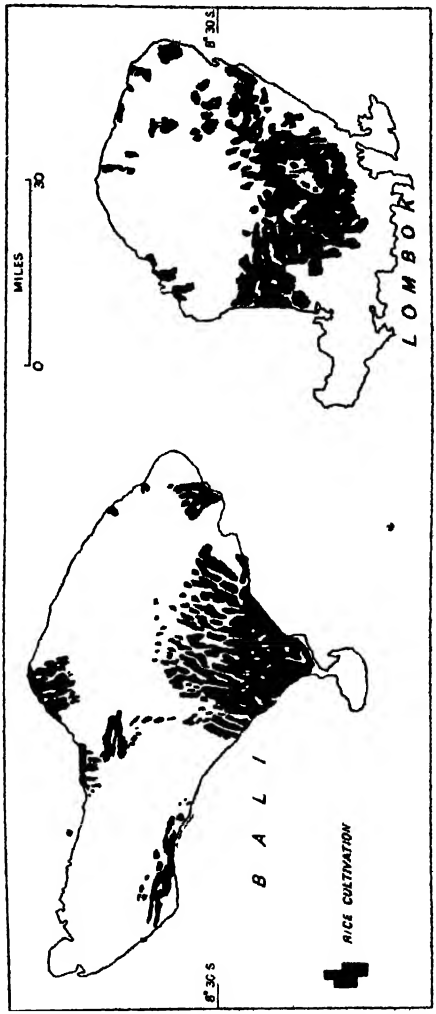

FIG. 85.—Rice Growing in Bali and Lombok

is accordingly very high (Fig. 85).

The volcanic zone of Lombok is more like an elliptical cone and there are few caldera—Rindjani (12,200 ft.) and Nangi. Here the steep dry northern slopes are notably unpeopled and the gentler southern slopes lead down to an inclined rectangle of intensely cultivated and irrigated land. Towards the east, the climate becomes distinctly drier, taking on an almost Australian aspect, with prickly pears and cockatoos indicating the migration of Australian flora and fauna.

The people of Bali are still Hindus. They have descended from high caste Hindu Javanese pressed eastward during the Islamisation of Java, yet retaining an aristocratic society and strongly communal life which finds expression in an elaborate artistic culture reaching higher forms here than anywhere else among the island peoples. Their temple architecture is unusually striking and complex. In Lombok the Balinese are outnumbered by "lax Muslim" Sasak people. Population in each island concentrates upon the fertile southern volcanic slopes. In the Gianjar district of Bali there are 2,300 people per square mile and the whole island averages 1,000 per square mile, to total 1.5 million. Lombok has little

less than a million people and a lower average density—750 per square mile. Each island contains about 250,000 acres of wet paddy (Fig. 85) and Bali has a further 120,000 acres under maize, together with a wide range of other food crops cultivated on a subsistence basis. The Balinese have an old tradition of craftsmanship in wood, stone, gold, silver and weaving, which has an export value. Their principal money industry is the rearing and export of pigs for the Chinese consumers of Southeast Asia. Neither of the islands has good harbourage and international shipping normally passes between them without stopping.

Chapter Seventeen

THE NATURAL LANDSCAPE OF SIAM

In many respects, Siam resembles Burma. Both countries have a south-facing trough form, similar climates of alternating wet and dry seasons, similar interest in a single major river system, considerable cultural likenesses between their people, and similar economic structures based on the export of rice and teak. Their differences derive from Siam's more southerly latitude, and from aspect, which influences the Siamese climate adversely from the rice-growing point of view, and leads Siamese external relations towards China (particularly in the past) and towards the trade streams of Southeast Asia. Siam is, however, the least documented territory of Southeast Asia and even its place names have not yet been uniformly phoneticised.

Siam is laid out very simply (Fig. 86). To the west are strung out old mountain systems which extend into Burma in the one direction and into Malaya in the other. To the north, an eroded plateau forms a broken upland terrain, resembling the Shan Highlands, of which it is an extension. To the east of Siam is a low platform, the Korat Plateau, with two scarps facing west and south as ramparts separating it from Central Siam and combining as a high bastion to the southwest where Kao Lem (Khao Khiaw) reaches 4,100 ft. Between these three units is Central Siam, a trough comparable to the Irrawaddy Basin, forming the heart of the country though less dominated by a single stream. Into Southeast Siam juts a small extension of the Cardamom Mountains between which and the Korat Plateau is a broad low corridor drained by the Prachin River and leading from the plains of Tonle Sap to the Gulf of Siam.

Siam's eastern boundary, mostly one of natural repulsion, runs for miles along the Middle Mekong, then follows the south Korat scarp to become a watershed boundary in the Cardamom Mountains. With Burma, Siam shares a complex watershed boundary zigzagging down the skew coulisses of Tenasserim and Tavoy in such a way that near Sam Roi Yot the boundary approaches so

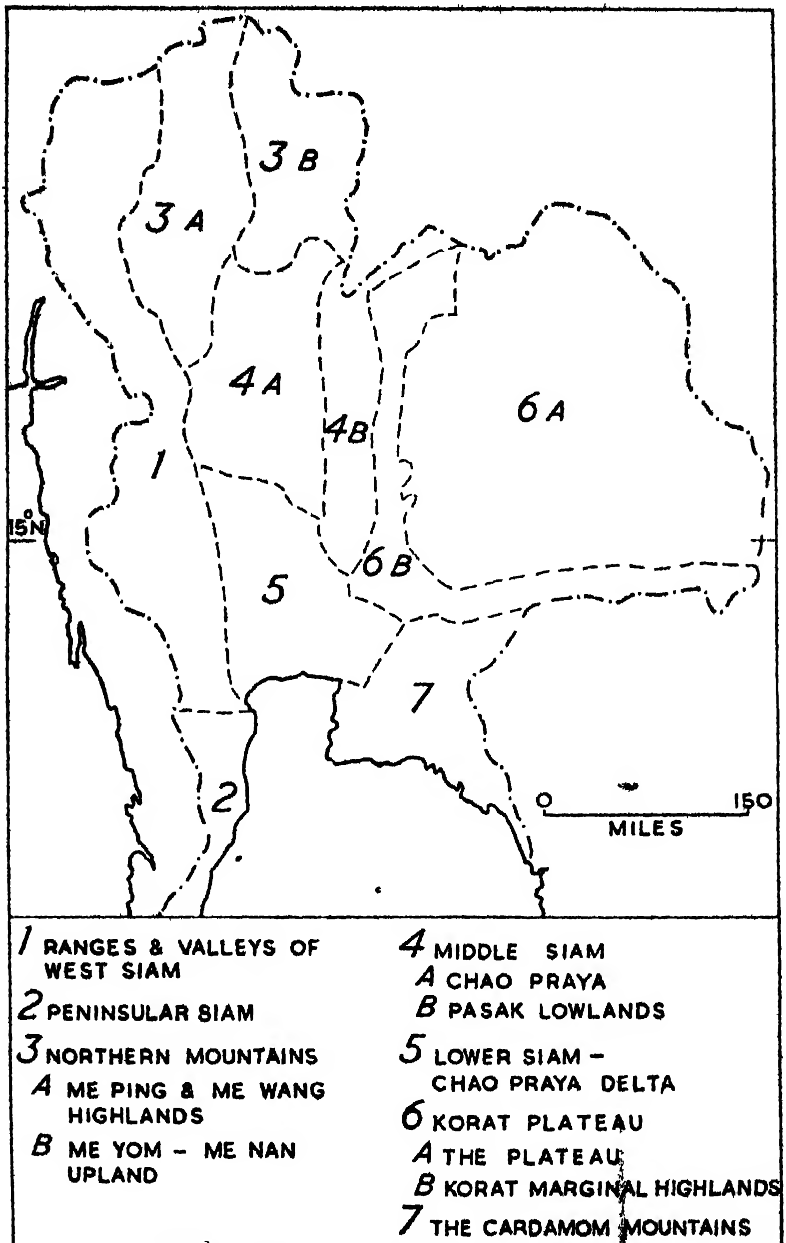

Fig. 86.—A Regional Division of Siam

near to the Gulf of Siam that Peninsular Siam, the Kra Isthmus, is almost separated from Continental Siam. To the north in the Shan country, the boundary is also a watershed boundary, though it runs for some miles along the Salween gorge and even returns to the Mekong at its incised mountainous section near Chieng Sen.

LANDSCAPE TYPES

1. *The Western Mountains* (Fig. 86) follow patterns already fully described in the comparable parts of Malaya and Burma. In detail these alternations of low corridors separated by lines of high granite mountains flanked occasionally by patches of limestone producing a landscape resembling the karst, show varieties of disposition though not of landscape type—and these dispositions moulded historic overland routes. North of Sam Roi Yot, the mountain lines run NNW. to SSE. and the parallel wet valleys drain two ways, to Burma and to Siam, converging upon Moulmein and Radburi respectively, and used as mediaeval trade routes particularly along the Meklong Valley. South of Sam Roi Yot, the granite ridges first assume a line NNE-SSW., becoming meridional farther south when crossing into Malaya. Here the Kra Isthmus is at its narrowest (about 35 miles in lat. 10° N.) and the short torrents have laid down tin-bearing alluvials on the flanks of nearly every granite outcrop. This was also the location of overland routes between east and west, of which the Takuapa-Bandon route was typical. It was largely a route for small river boats, only a short section needing portage which, in so forested a setting where draught animals are scarce, was always critical and difficult for traders. None of these trans-isthmus routes have modern significance; on the Radburi-Sisawat-Moulmein route the Japanese began a wartime railway which is now out of use and offers little prospect of commercial operation.
2. *The Northern Mountains*, an intensely folded old-mountain system of shales, schists and limestones, are in an advanced erosional stage and their intrusive granite cores are exposed on distinctive N-S. lines. Many streams flow south from this extension of the Shan Highlands and through the Central Siam depression. Between Lampang and Pre is one of the few volcanic outcrops in Siam, which today has no active volcanoes. The

region contains the highest relief of Siam and in its valleys are fertile pockets of alluvials which have attracted peoples from the harsher north. Its southern limit is a latitudinal line about $17\frac{1}{2}°$ N.

3. *The Korat Plateau* has characteristics unique in Siam and all Southeast Asia. It is a practically horizontal bed of red sandstone lying unconformably and almost undisturbed upon that general mass of eroded faulted rocks apparent at the surface in most adjoining regions (Fig. 87). This sandstone plateau,

FIG. 87.—Section of Korat Plateau Sandstones. 1. Lowland forest. 2. Bamboo with isolated trees. 3. Tropical rain forest. 4. Dwarf trees capping bare scarp. 5. Savannah with scattered pines

while averaging about 500 ft. above sea level, tilts slightly from scarps of above 1,500 ft. at the east and south, towards the Mekong, shedding eastwards its streams, the Nam Chi and Nam Mun, and giving the whole region an outlook towards the Mekong and away from Central Siam. The landscape is square-cut with broad, flat, incised valleys and flat-topped interfluves like mesas in which the watertable stands well below the surface for most of the year. The sandstone plateau terminates in linear scarps, (possibly of fault origin) to the west and south as the Dong Paya and Dong Rek, in the neighbourhood of which small outcrops of ancient volcanic tufa have been found. Equally sharp is the termination of sandstone north and east overlooking the Mekong Valley. Along the Nam Mun and Nam Chi wide marshy flats extend latitudinally almost right across the Plateau, as the only well-watered areas in an otherwise dry area, and they are subject to inundation by Mekong spates as is the case with Tonle Sap. Below the Nam Mun junction, the Mekong enters a gorge-like bottleneck where sandstone barriers in places extend almost from side to side. During heavy rains this rocky impediment causes the Nam Mun to be inundated far upstream by a rush of water from the Mekong, aggravated by rain-floods on Korat itself. A similar condition occurs in most of the lesser streams flowing

from the sandstone into the Mekong, though most Korat drainage goes to the Nam Mun before reaching the Mekong. The Nam Mun valley is thus a flat belt of seasonal marsh (Fig. 90) which remains the longer because the main stream has built levees which prevent quick drainage of flood-water back to the river. Upon the Plateau capillarity causes salt frequently to flower at the surface during the summer, when it is collected for domestic use and traded by caravan routes into Yunnan as well as into Central Siam. An outlier of Korat is found at the Mieng Hills northwest of Petchabun. In the southwest corner of the Plateau appears a line of granite hills in continuation of the Cardamom Mountains.

4. That portion of *the Cardamom Mountains* in Southwest Siam repeats features found in Cambodia (see Chapter 19) with a difference of aspect: the Siamese section has a number of fertile alluvial valleys opening south to the Gulf of Siam. These valleys are moderately peopled and cultivated. The low hills of these peneplained folded rocks extend to the straight eastern side of the Bight of Bangkok where a fault structure extends the line of the Dong Paya scarp.
5. *Central Siam* may be described as a depression floored by highly eroded complex-structured sedimentaries mostly reduced to levels below 300 ft. and is generally masked by river alluvials. It extends to lat. 17½° N. north of which mountains appear, to the scarp of the Korat Plateau where it terminates as a meridional line, and to the west where it ends in a fairly straight line against the Tanon Tong Chai and Tenasserim Ranges. It remains to be verified geologically whether this is a fault depression or an erosional basin.

While Central Siam is often called the Menam Valley, there is in fact no River Menam; Menam means river in Siamese. Four main streams enter the depression on practically N-S. lines from the Northern Mountains of Siam. Three of them, the Metun, Ping and Wang combine near Ban Sop Woung and are joined near Nakawn Sawan by the Nan and the Yom to form one single stream for about 25 miles, but from Chainat southward these combined waters braid into distributaries of which the chief are the Tachin on the west and the Chao Praya to the east. It is this main distributary, the Menam Chao Praya, which is meant conventionally by describing the "Menam" as the chief river of Siam.

The easternmost distributary receives near Ayuthia the waters of the Pasak, a river which distinctly parallels the Dong Paya scarp.

The Prachin, draining the depression between the Korat Plateau and the Cardamom Mountains, makes a sharp bend southward so that it does not join the main drainage system of Central Siam but separately enters the Bight of Bangkok. The Meklong flows from the Western Mountains southeastward to make a similar separate entry to the Bight, though artificially connected to the Menam Chao Praya by parallel canals (for irrigation and transport) across the deltaic plain along one of the old trans-isthmus routes between east and west. These rivers periodically have great volume and heavy silt load; they have built up large alluvial fans and deltas and are still steadily filling the Bight of Bangkok.

As with the Irrawaddy Valley, we may distinguish two distinct parts of Central Siam:

(*a*) *Lower Siam*, the flat deltaic alluvials forming a trapezoid from the Bight to the points Prachinburi on the Prachin, Saraburi on the Pasak, Peiyuakiri on the Chao Praya and Raiburi on the Meklong. Within this area the relief of levees and alluvial banks alone rises above the surface, which is only a few feet above sea level (Fig. 92).

(*b*) *Middle Siam*, the northern part of the trough of Siam, characterised by rolling hill and valley relief crossed by lines of much-folded shales and schists. The narrows below Nakawn Sawan indicate that the substructure runs athwart the drainage lines to form an almost enclosed basin to the north. Beside the main rivers are alluvial flats containing braided streams, thus extending far inland long fingers of landscape resembling that of Lower Siam. The Pasak Valley is large and disproportionate to the present river within it; it follows a linear form apparent on the Mekong between Luang Prabang and Paklay and is in turn extended south by a tributary of the Prachin, suggesting that the Pasak once flowed separately to the Bight as an old course of the Mekong.

Exploitation of minerals in the rocks of Siam is negligible, apart from the Kra tin mines. A few people wash river gravels for gold in the Nam Nigau valley (tributary of the Mekong) and some of the Kra valleys, though these last can be relics of old trade routes

rather than signs of local veins. In the Nam Wa of North Siam, at Chon Luk in Dong Paya and at Muang Kut in the east, the copper mines no longer operate. Galena has been worked commercially at Kanchanburi and tungsten ores in the Kra Isthmus. A few gems continue to be found in the Cardamoms. Iron ore is widely distributed but unworked owing to transport and fuel difficulties. The only known Siamese coal is an unworked lignite near Nakawn Sawan. All tin from Kra was shipped coastwise to Penang or Singapore for smelting. Exclusively a foreign investment of European or Chinese capital, the tin mines worked with Chinese labour on systems (particularly dredging) already developed in Malaya. About 17,000 tons annually was Siam's normal tin production capacity in the years immediately before the war and its 1950 tin export was about 8,800 tons.

CLIMATE

The climate of Siam relates to climates of the adjoining territories of Burma, Indochina and Malaya. The Kra Isthmus experiences the North Malayan type of climate with rains at all seasons and two distinct maxima. The Central Depression is distinctly dry (Fig. 88), receiving rains only when the summer airstream comes directly from the south, otherwise the Western Mountains shield the Menam Chao Praya Valley, producing a dry zone resembling that of Central Burma. The high surroundings of Central Siam deny the region any significant amelioration of drought by occasional cyclones. Typhoons from Indochina and the South China Sea rarely reach even the Korat Plateau.

Thus, excepting the Kra Isthmus, all Siam has less than 1 in. of rain for each month from December to April. Rains then set in with an abruptness like those of India and Burma, at the end of April, to continue until mid-November. The volume of rain varies from district to district according to aspect and altitude so that in July, for example, southeastern Siam and all the mountain areas receive over 10 in. of rain, while Central Siam and Korat receive less than 10 in. By October the rains diminish throughout Central Siam.

Relief largely determines the pattern of annual rainfall totals, according to the few long-period records which have been kept. The higher edges of Korat receive as much as 120 in. p.a. whereas

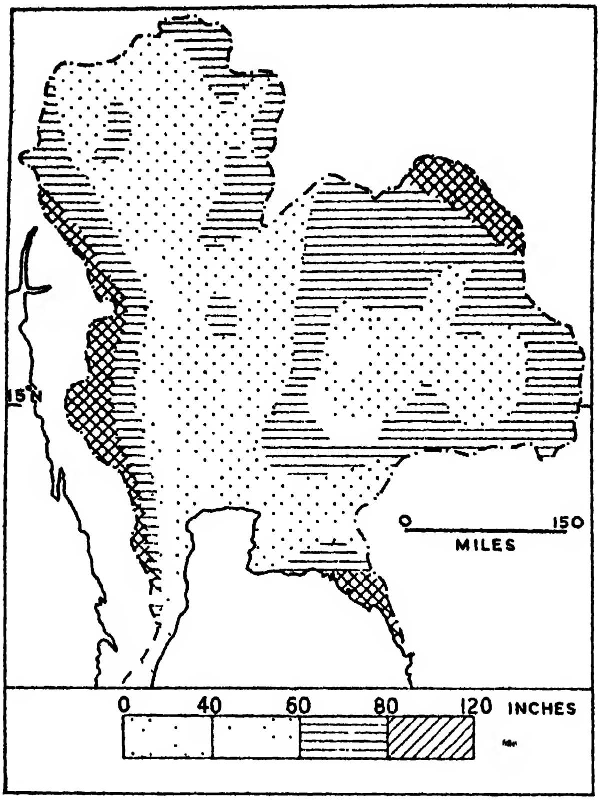

FIG. 88.—Rainfall in Siam

the lower plateau areas receive less than 60 in. and even less than 40 in. in the rainshadow east of the Dong Paya scarp.

SIAM: AVERAGE RAINFALL (in inches)

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Bangkok	.9	1.0	1.3	1.9	6.8	6.4	6.9	7.3	11.6	7.8	2.1	.7	54.6
Kanburi	.9	1.0	1.3	2.3	6.4	5 2	5.3	3.8	7.8	6.9	.7	.4	51.3
Nakon Nayok	1.0	1.1	1.9	2.3	7.9	11.6	14.5	16.5	16.7	7.3	2.6	.5	83.9
Chiengmai	.4	.1	1.0	1.6	6.0	5.1	5.7	9.1	9.5	6.7	2.3	.5	48.0
Udorn	nil	0.7	3.0	3.7	9.1	10.4	8.6	8.4	9.9	2.2	1.2	nil	57.2
Takuapa	1.1	1.3	6.1	7.5	17.7	20.5	23.8	23.9	33.3	21.2	9.2	3.1	168.7

Central Siam everywhere receives less than 60 in. while on the eastern foothills of the Western Mountains a narrow belt of rain-shadow from Prau Kao on the Bight to Raheng on the Ping River

has less than 40 in. p.a. Thus Central Siam has a rainfall resembling the Dry Zone of Burma but there is no increase of rain towards the southern plains, which continue dry all the way to the Bight. Upon the Korat Plateau a similarly low rainfall is emphasised by the porosity of the red sandstone and comes in a season of about 200 days, during which high temperatures prevail to lessen the effectiveness of the low rainfall.

A climatic drawback is the wide variability in the Siamese rainfall from year to year, always a critical factor in drier climates. Over the period 1914–25 the wettest years differed from the driest years by as much as the average rainfall at Bangkok, and the length of the wet season varied from 174 to 236 days per year.

Low rainfalls in Central Siam have several effects. Because the streams are relatively short and originate within the Siamese climatic régime, their volume fluctuates widely during the year and their load at the onset of the wet season is abnormally heavy due to the ease with which rain scours the dry dusty surface. Such an alternation in the rivers produces bars across their mouths. The Chao Praya at Paknampoh has a flow of scarcely 4,000 cub. ft. per second during the dry season, becoming 54,000 cub. ft. per second in the wet season. At Bangkok the flood discharge is of the order 95,000 cub. ft. per second. The rise begins rapidly in May and continues until the end of October, after which it falls gradually to a minimum in April. For fifty miles inland the distributaries of the Chao Praya are subject to tidal influence particularly during the dry season, making the lower reaches of the river brackish and creating a problem from the farming and potable water point of view, while helping to scour the channels slightly. The Chao Praya mouth can be entered only at high tide owing to the sandbars which are very little modified by marine currents because the Bight is so sheltered. Other streams are unsuited for navigation even at their mouths; the smaller rivers like the *chaungs* of Burma, dry out to a trickle among banks of gravel during several months, when water shortage dominates Siamese life everywhere outside the main river valleys.

VEGETATION

The Korat Plateau and Central Siam are covered by the dry deciduous type of Monsoon Forest (Fig. 89) in which bamboos predominate, much subject to fires in the dry season and becoming

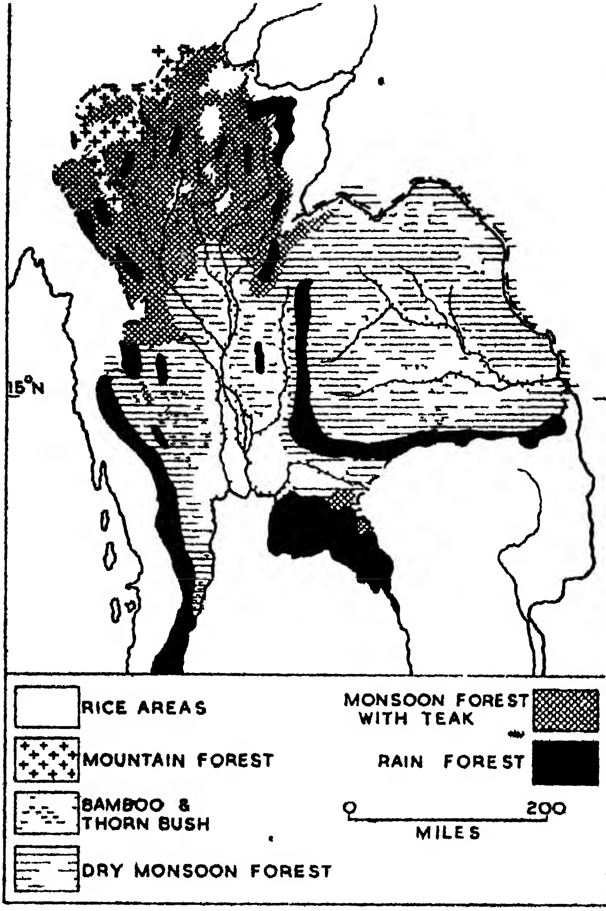

FIG. 89 —Siam—Vegetation

savannah or scrub in type after frequent burnings, whether caused naturally or by shifting cultivators. Higher altitudes everywhere induce an approach to Tropical Rain Forest because they receive heavier and more regular rains and the Kra Isthmus is practically entirely of this type of forest. North of about 17° N., apart from the occasionally cultivated alluvial valleys, the landscape is deciduous Teak Forest, Northern Siam repeating in this respect the pattern of the Irrawaddy Basin. Some six foreign firms had leases to extract teak from this area up to 1942 and over a million logs a year were cut from Siamese forests, dragged to the

water-side by elephants and floated down to the coast during the wet season beginning in May and June. A little Siamese teak moved out by way of the Salweep and the Mekong but at least three-quarters went by the Chao Praya to Bangkok. About half the commercial teak was from the Yom valley, and a quarter each from the Wang and Ping Valleys. Recently legislation stipulated re-forestation after cutting the teak because it was becoming

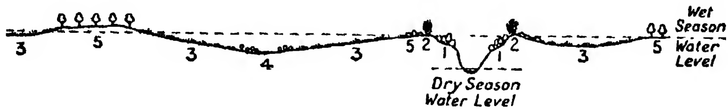

FIG. 90.—Rivers and Swamps in Korat. 1. Evergreen shrubs and small trees. 2. Thorny bamboo lining levees. 3. Grasses. 4. Marsh. 5. Park-like savannah above wet season water level

apparent that the extraction rate was faster than the natural replacement and was causing hill erosion to increase. Near Bangkok were many teak mills though logs also went to Singapore for milling, in company with much Siamese rattan, for which Singapore was also an entrepôt. The timber trade has been a declining one since 1907 and the demand for Siamese teak fluctuated widely, its pace being set by Asiatic rather than by European or American consumers. After its wartime stagnation, teak extraction showed no sign of recovery by early 1948.

Peculiar to the valleys of Korat is the great development of seasonal Freshwater Swamp Forest. The flat lands away from the rivers (Fig. 90) are inundated during the wet season, which encourages a profuse vegetation and this in turn becomes an impassable forest in the dry season. Thus the landscape when dry resembles the worst savannah-scrub, lined with bamboo on the slightly higher ridges, and when wet resembles young swamp forest found in latitudes much farther south.

Chapter Eighteen

THE CULTURAL AND SOCIAL LANDSCAPE OF SIAM

THE agriculture and the social structure of Siam hinge upon rice farming, yet by comparison with conditions elsewhere in Southeast Asia this territory by no means has optimum rice conditions. In particular, the low and unreliable average rainfalls of the whole riverine plains and the brevity of the rainy season operate against rice farming. Zimmerman considered at least three-quarters of Siam was unsuited to rice cultivation.

OLDER FARMING SYSTEMS

Probably almost a million Siamese people in the northern and western mountain districts and on the Korat Plateau still regularly depend for their food on shifting cultivation. The amount of land used in this way is probably half a million acres in any one year.

Outside Lower Siam where special conditions operate, farming is of the subsistence type and agricultural produce does not move in an appreciable quantity from one district to another. To the north the subsistence farming is based upon glutinous rice, less because the glutinous type is preferred dietetically and more because that type matures in the short period of about 4 months, making it a safe crop for a district whose rainy season is unreliable and never longer than 4½ months. The same consideration causes Korat to devote 70 per cent of its farmland to glutinous rice.

Supplementary to this staple peasant food are many other crops for local use, all of them tolerating the low rainfall, short wet season and long dry season, but the riceland is never re-cropped in any one year. Tobacco, a little cotton, fruits, tea (on the uplands) and vegetables are produced in this subsistence system. For the whole of Siam outside Kra, the non-rice crops occupy in total less than 3 per cent of the cultivated land. Of these, only the tobacco and tea (a pickled variety for chewing rather than for brewing) provide a small cash income. For rice growing, areas away from the main rivers depend fundamentally on direct rainfall supplemented by direct flooding from the smaller rivers where this takes

place naturally. Controlled irrigation with dams and distributary canals is negligible.

In the Korat valleys rice grows on the fringes of the seasonal swamps and the timing of planting and harvesting is related to their natural floods. Any cultivation behind the levee banks of these swamps must wait for the river itself to subside, because no method has been evolved to drain to the river which is then standing at least as high as the water in the fields. Frequently there arise communal clashes of interest in the Korat swamps: peasants who live by catching the freshwater fish brought to the swamp by the river in spate, work for the quickest possible draining of the swamp as the river subsides; paddy-farmers on the other hand need the water to be retained behind the levees as long as possible. It is remarkable in this Southeast Asia region, where water control has generally reached a high standard by methods devised under and for local conditions, that paddy farmers of north and east Korat, where conditions are unreliable, should have evolved no irrigation of their own, not even the simple water-gate to use the swamps behind the levees as water storage tanks. Water scarcity sets the key of all Korat activity; the combination of low and unreliable rainfall, high evaporation, porous sandstone and low watertable leaves the people critically dependent on the brief natural floods of the river valleys. Less than 7 per cent of the Plateau is cultivated, much of this being on the shifting system and less than 2 per cent being in crops other than rice. All processing and cultivation is haphazard here. Of land reported to be under rice in the 1946–47 season, 10 per cent was in Central Siam north of Nakawn Sawan and about 30 per cent in the Korat Valleys where there is always quick response to rice prices, a rise of which encourages catch-cropping in marginal areas. Only a very small portion of the rice thus produced moved out of these localities.

In the Kra Isthmus is another minor subsistence agriculture, similar to that of Northern Malaya.

The Commercial Agricultural Régime

The deltaic plain of Lower Siam (Fig. 92) is the zone of specialised rice agriculture, resembling in its position within the state and in the economic machine the commercial rice-producing zone of Lower Burma but with differences in method. For 1946–47,

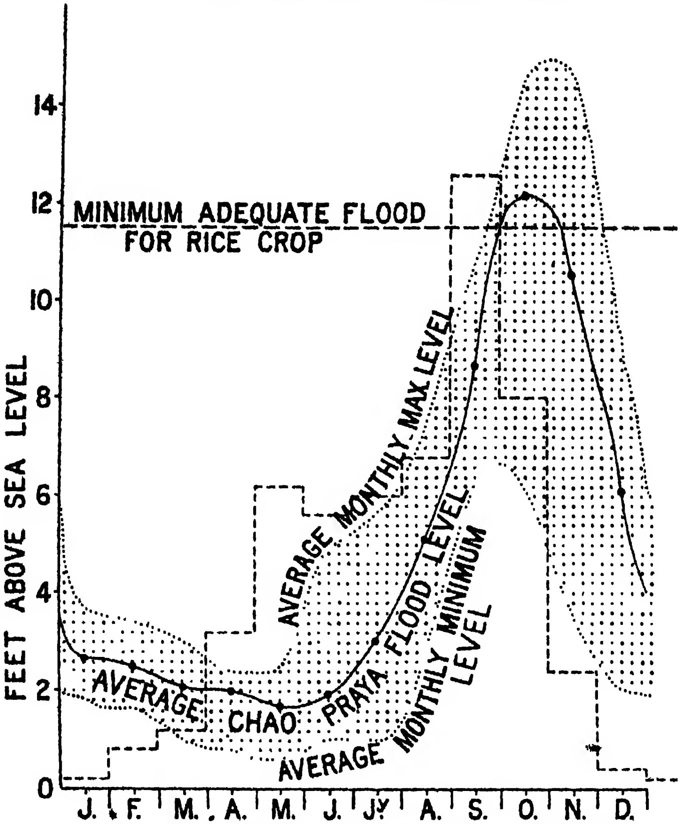

FIG. 91.—Rainfall and River Régimes at Ayuthia

nearly 6 million acres of paddy were being cultivated in this restricted region, representing over 54 per cent of the paddy area of Siam. Precipitation everywhere in Lower Siam is less than 60 in. p.a. and is only just over 50 in. at Ayuthia in the heart of the rice country, as against the minimum wet paddy requirement of 70 in. p.a. The effective rainfall is considerably less—about 40 in. only for the critical months when paddy is in the ground (Fig. 91). Thus we have the unusual circumstance of a large-scale commercialised rice production—almost all Siam's rice export derives from Lower Siam—in an area without adequate rainfall for rice.

All rice grown in Lower Siam for trade is non-glutinous and wet-cultivated. Rainfall deficiency is made up by direct floods

from the rivers whose spate in the deltaic sector of the Chao Praya is about a month after rains begin in the mountains of the north. The whole plain is canalled for simple distribution of the spate. Because most of the fields are fed by gravity without an artificial head of water, the duration and depth of flooding are uncontrollable and the crop risks are very great. There are the risks of inadequate depth of flood, too much depth, inadequate duration and too prolonged duration, so that the harvest has a wide variability. At Ayuthia over a century of observation, only 32 per cent of the years had adequate floods, 22 per cent of the years they were barely adequate, 30 per cent of floods were far too shallow and 15 per cent too deep. These are the consequences of having neither dams to store, dykes to protect nor adequate canals to distribute and balance the supply of field water.

To provide adequate floods for the rice areas, the Chao Praya waters at Ayuthia must rise to at least 10.5 ft. above the average level of the Bight of Bangkok and the success of any one crop depends on maintaining this level for a sufficient period to mature the rice. Maintenance of level depends in turn on the continuation of rains at the headstreams of the Chao Praya; should August and September be unusually dry in North Siam, a sharp drop of the Lower Siam floods occurs and the rice plants cannot mature—with serious results for the commercial economy of Siam. Thus in 1919 when the minimum 10.5 ft. of flood at Ayuthia was not reached at any time, over 2½ million acres of rice were destroyed, representing 43 per cent of Siam's total paddy acreage for the year.

The precariousness of agriculture in these circumstances has been recognised and a modern canalisation is now complete in the Khlong Rangsit area northeast of Bangkok where Pasak and Pakong water is led to half a million acres of paddyland east of the Chao Praya. The area is being extended but west of the Chao Praya no control works of this type have been carried out.

Since the Chao Praya has a heavy load in spate and varies in volume rapidly, silting is a constant problem in the channels and in the fields. Distributaries build up levees, which in time they penetrate, leading to a change of course (Fig. 92). There are signs of steady migration of distributaries to the east, leaving what were once good rice areas with every expectation of floodwater to become relatively unimportant and unreliable producers, as in the Suphanburi district where a heavy rice production was obtained

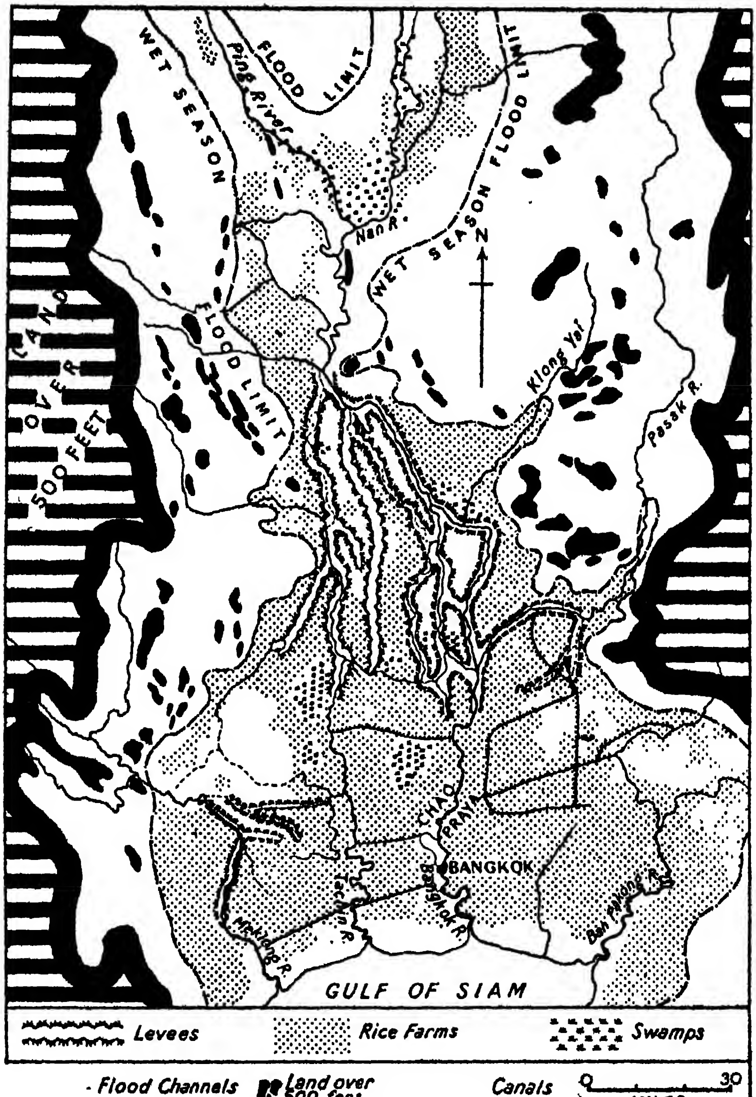

FIG. 92.—Landscape and Land Use in Lower Siam

in the 14th century when the Chao Praya reache the sea by way of what is now the silted up Thachin River.

During floods, Lower Siam is in effect under water to depths varying from a few inches to as much as 10 ft. Th canals (*klongs*)

are aids to water distribution and do not significantly drain the landscape. They are, however, the only practicable routes and the rural areas are linked by shallow-draught boats along these *klongs* which are at once agricultural aids, the high street, the sewer and the water supply to local people. The nature of the floods is a factor maintaining fertility but the migration of the waters and the frequent silting up of channels cause a shift in the location of the most favoured and reliable rice-growing areas. Without controlled irrigation, any area built up above the general level by sedimentation will no longer be flooded and must fall out of cultivation.

Rice

The Lower Siam fluvial plain is a one-crop area. Rice for sale dominates all else, but there is a little vegetable growing near Bangkok and fruit and peppers at Chandburi. A few districts grow legumes and maize for local domestic use and transitional forms of self-sufficiency farming appear towards the margins of the normal flood zone. In the technique of rice cultivation, great differences may be found close together. The areas with most dependable floods follow the transplanting system, timing the field work so that preparation of the ground by ploughing is done as soon as the beginning of local rains softens the baked fields, and transplanting into flooded fields takes place later when the spate reaches the plain. If the local rains and the spate happen to come almost simultaneously, then broadcast sowing is adopted, as it is also where the farmer has inadequate assistance for transplanting. Broadcast sowing yields poorer crops and permits less accurate adjustment to local floodwater vagaries. The minor vegetable and legume-maize-pepper-tobacco cultivations are in areas working from direct rainwater rather than from floods. In every case cultivation and processing is by manual methods until the rice leaves the farm.

The rhythm of activity in Lower Siam is rather short and more sharply defined than in most paddy areas. July is the peak planting month and December the peak harvesting month. A spread of activity arises from differences in the date when spates appear in different parts of the lower Chao Praya and in the middle Mekong (which controls Korat planting seasons).

Although paddy cultivation in Lower Siam is non-intensive and

precariously related to the natural conditions in any one year, the acreage under paddy has steadily increased.

PADDY FARMING IN SIAM

Quinquennium	*Area under paddy p.a. Million acres*	*Production clean rice p.a. Million tons*	*Average exports clean rice Million tons*
1910–1915	4.54	1.92	.8
1916–1920	5.50	1.92	.7
1921–1925	6.45	2.76	1.1
1926–1930	7.14	2.71	1.2
1931–1935	7.93	2.94	1.5
1936–1940	8.45	2.71	2.0
1946–1950	10.40	3.40	.87

Between 1910 and 1940 an additional 5 million acres came into cultivation, mostly in this delta sector, an expansion which was not so much as in Burma for the same period but was an impressive additional acreage to have been put under rice by Siamese farmers alone. Foreigners have played no part in the increasing farming labour, all of which has been done by Siamese and their families who have in that time considerably increased in number, though not quite so fast as their rice acreages.

The Land Question

Until early this century, land had little value in itself. It was often communal and held on what were in effect squatters' rights. There were still in existence large individual land holdings dating from the period when Siamese officials were granted land according to their rank, in lieu of salaries. At that time so much land was unclaimed that it could be had for the asking, subject to the claimant being able to farm it. Confusion began to arise in land questions as population increased and the best lands were fully taken up. The farms were often unsurveyed and without deeds, as much of Siam is even today. In the delta, floods regularly obliterated landmarks, making identification of property difficult. After 1912 when rice and ricelands began to have a significant money value in Siam, new lands were authorised publicly in the hope of encouraging smallholders to settle on them, but in effect, big landowners obtained even bigger holdings and went in for land speculation which intensified at each stage in the expansion of rice exports. Delta farming property has become

concentrated into large units and the bulk of commercial rice today comes from great estates cultivated by a changing stream of tenant farmers supervised by a rent collector for the absentee landlord.

Round Bangkok and in Rangsit the farms exemplify this property concentration. They are larger than anywhere else in Siam and at Dhanyaburi nearly 85 per cent of peasants are tenants. Tenancies average 40 acres each, usually on a yearly basis, so that there is no need and no encouragement to form a settled village life. Thus the commercial rice is produced by migrating farmers who pay rent, who cultivate very little food for themselves and have no reason to improve the land. Naturally these short-term tenants extract as much as possible from any field they rent, irrespective of the effects of overtaxing the soil, which passes to other hands the following year. It is not surprising that after the progressively heavy rice exports of the 15 years to 1935, the next quinquennium showed an alarming decline of yield per acre, by about 25 per cent compared with 1921-25.

The system of renting ricelands led to borrowing from money-lenders, because the tenant suffered the losses arising from Nature's variations, which are very considerable, as has been demonstrated. Where tenant farmers started off by possessing a little family land and rented a field or so in addition, their personal property was steadily lost to cover the risks. The landless population has thus swollen, to total 36 per cent of the families in Lower Siam by 1930, making available that supply of landless labour which is needed seasonally on the great rice farms. Outside Lower Siam, harvesting and planting are communally organised among the smallholders. Within Lower Siam it must be done with hired labour—an additional burden on tenant farmers, whose outgoings are thus all in cash, for rent, land, taxes and wages.

Milling.—Rice mills are located near Bangkok and they extend along the major water channels by which rice moves through Lower Siam. The movement of rice to mills is loosely organised. Rice leaves the farm in small units and the tenant is without means or knowledge to negotiate directly with the mills. Hence there has grown up a complex middleman system mostly run by Chinese, which handles all movement and storage from the farms to the mill. It is this phase in which holding for a market rise may take

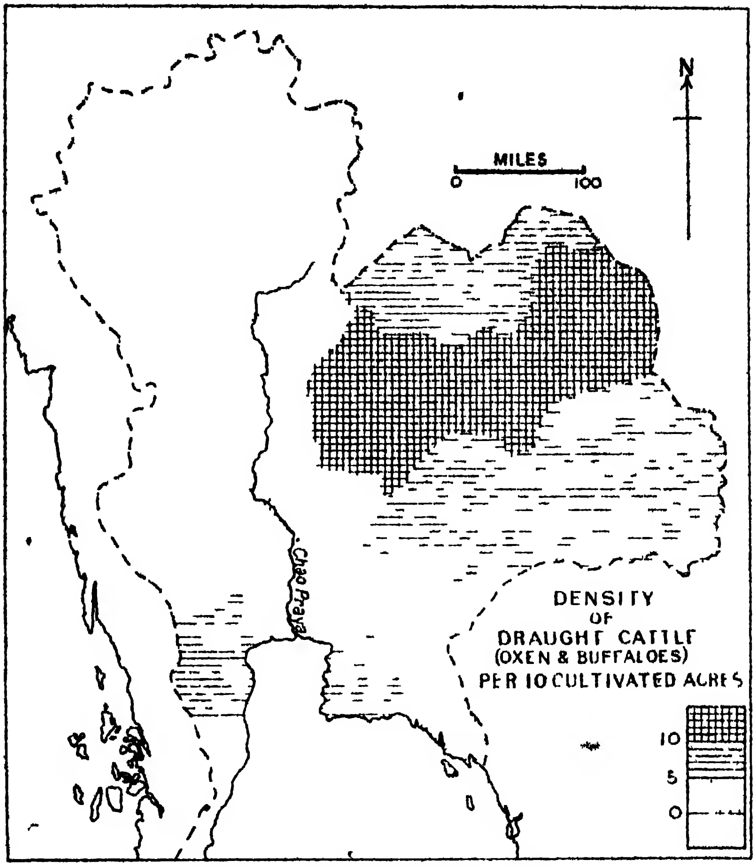

Fig. 93.—Density of Cattle in Siam

place. The impecunious tenant farmer must turn his rice into cash as quickly as possible to meet his obligations, a condition by which the middlemen profit, as they do also at the stage of bargaining with the mill which wishes to purchase for export. Thus the benefits of improved rice prices are denied the farmer and taken by the middleman. It is doubtful, however, whether the increasing rate of extraction of rice from the countryside and the commercialisation of Siamese rice would have been possible without the initiative of the Chinese middleman.

Of the .87 million tons of rice exported annually on an average over 1946–50, 25 per cent went to Singapore for Malayan consumption, 9 per cent to Hongkong, 15 per cent to India and

9 per cent to China. In this movement, carried out by foreign shipping from the one port, Bangkok, the proportion to Hongkong tended to decrease in postwar years, while that to Singapore, India and Japan was increasing.

Cattle

A variant on Siamese monocultivation of rice is the cattle breeding which goes on in Korat. Rice farmers throughout Siam use buffaloes and oxen as their draught animals. Usually each family has a pair of animals, buffaloes being preferred in Lower Siam and bullocks elsewhere. In Korat, however, the average smallholder owns just over four of these animals and the savannah setting plus fodders from the local subsidiary maize growing, suit this small breeding activity, which supplies draught animals to the cultivators of Lower Siam. But Korat has no specialist cattle farming. The animals come from smallholders, not from herds of cattle on a grazing terrain. Caravans of these small cattle make their way from Korat to Lower Siam throughout the year. In the Plateau area some 5½ million cattle are usually living (1942), an average of 3.2 per acre of riceland as against an average of .7 per acre in the Siamese plains (Fig. 93). From Korat, too, comes a steady supply of pigs, in demand by the Chinese of Bangkok and exported to Chinese elsewhere in Southeast Asia.

The Population Pattern

Siam is as thinly populated (Fig. 94) as the greater part of Burma and North Malaya. A general average of 87 persons per square mile is distributed so that Lower Siam has a density of over 250, the Korat Plateau and the teak country of the north have between 50 and 100 people per square mile, while the Western Mountain zone has less than 50 per square mile. Densities round Bangkok resemble those of congested parts of the Tonkin deltas but Tonkin is an over-populated emigrating area, while the Bangkok zone ranks neither as over-populated nor a source of migrants. The difference is largely one of "nutritional density," population per acre of paddy (Fig. 95). Lower Siam has only .86 persons per cultivated acre as against 2.6 per cultivated acre of Tonkin. In the same sense, the nutritional density of Lower Siam is far below that of most other regions of the country, which helps to account for the paradox of a large population

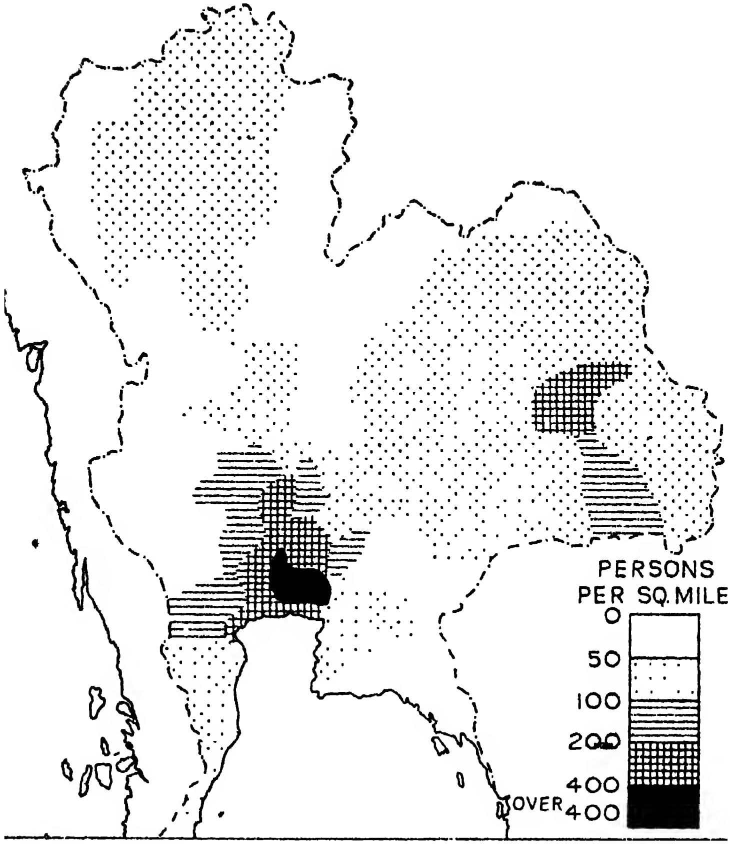

Fig. 94.—Density of People in Siam

and a large agricultural production for export (compare also Fig. 61).

Of Siam's total population, 14.5 million in 1937 and estimated to be 17.6 million by 1950, about 850,000 are in Bangkok itself, the only significant town in Siam, 88 per cent of Siamese live in rural villages, and the rest in small market towns. While census reports in Siam are difficult to correlate, Broek estimates the crude annual increase in most rural districts of Siam as between 4 and 6 per cent. Over the period 1929–37, 3 million locally born people were added to the population and by 1947 there was a further increase of 2.6 million. An increase of this size and proportion has been unusual elsewhere in Southeast Asia (apart from Java)

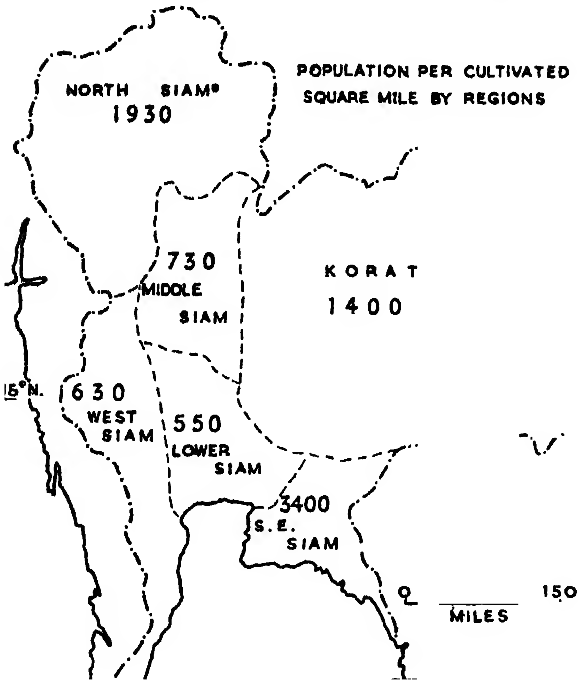

FIG. 95.—Nutritional Densities in Siam

over a similar period. During the 30 years 1907–37, Siam's population practically doubled, without immigration significantly influencing the totals or the high rates of increase in rural areas.

The rise of population has made it possible for the Siamese paddy acreage to become more than double in this century and for the rice exports nearly to double. This fast rate of increase may not, however, be a modern feature because an estimate of the total Siamese population for 1854 was only 6 million. Such a sustained natural increase of population justifies questioning Zimmerman's assertion that malaria, arising from the uncontrolled floods, has undermined the Siamese people. Indiscriminate drinking of canal-water has repeatedly produced epidemics of cholera and the panicky abandoning of whole centres of population, particularly on Korat, yet the rate of increase in Siam scarcely indicates progressive and cumulative debility, notorious though Siam may be for its swarms of mosquitoes and other disease-carrying pests. Historically the focus of population and of agriculture has steadily

shifted south from Chiengmai to what would appear to be the more unhealthy yet more productive settings of Ayuthia and Bangkok.

Siam has for two or three centuries suffered from labour shortage rather than over-population. This was the background of the slow approach on to the more fertile ricelands of the south and to the frequent slave raids upon surrounding territories. Slaves continued to be part of the Siamese solution of the labour question until the beginning of the 20th century and there is still a tradition of forced labour. Today the heavy seasonal requirements of workers in Lower Siam are met by temporary migrants from the northeast (the Korat Plateau), who stay in the plains for only about 6 months, leaving their families behind to look after their smallholdings. They return with a little cash which suffices for two or three years. Individuals do not apparently repeat this migration frequently.

The Chinese in Siam.—It follows from the shortage of people and the preoccupation of most Siamese with subsistence farming that the Chinese have been able to move into Siam in considerable numbers, as they have into most other Southeast Asia countries. Chinese coolie migration into Siam has taken the usual form. It was at first encouraged by the Siamese nobility and the Siamese peasants were indifferent. It fluctuated with the prosperity of the country and became an emigration during depressions. The movement has left a group of locally-born Chinese and Sino-Siamese who rank as Chinese by Chinese law and as Siamese by Siamese law. The Chinese became a target of Siamese nationalist indignation and were subject to discrimination. The net movement of Chinese for the period 1925-30 was into Siam at an average of 37,000 per annum, while for the period 1930-35 it was an average loss of just under 1,000 per annum. By 1939 there were just over three-quarters of a million foreign Chinese in Siam, though China claimed its nationals there numbered nearly 3 million. The Chinese community controlled the middleman and milling aspects of the rice trade, they were the artisans and skilled workers, the miners and the rubber planters of Kra, and the principal importers. They took little direct part in agriculture except as market gardeners near Bangkok, though they dealt in all agricultural produce, kept village shops, and commanded a key position in public affairs, more so than in any neighbouring country.

Indigenous Groups.—Among the indigenous people a wide ethnic range may be recognised. In Lower Siam, the Tai group (hence Thailand, sometimes an official name of Siam) dominates. North of Sukotai and in the Korat Plateau live Laos, part of that group widespread in inner Indochina and closely related to the Tai. In all the virgin forest areas are scattered nomadic peoples, of which the most numerous are the Karens who overlap the border with Burma, normally living at altitudes of 1,500–3,000 ft. Among the Northern Mountains at still higher levels are the "hill people" of whom the Miao, Lissu and Yao are representative. Round Chantaburi in the southwest are remnants of Khmer-Cambodian types and a few Annamites have moved round the coast as far as Bangkok. In Kra are the Semang aboriginal types, found also in Malaya. Along the Kra coasts are the Chao Nam, a group of "gipsy fishermen." Malays totalling about 600,000 occupy the border area south of a line from Singgora to Puket which is an ethnic-religious boundary well north of the political boundary. About 85 per cent of people in Siam are Tai-Lao, between whom there are only minor differences, so that Siam is fairly homogeneous, apart from the Chinese traders of Lower Siam and the Malays of the far south.

Customs.—The preponderance of Tais means that a single language runs throughout Siam except for the hill and jungle people (Fig. 118). Laos speech is a dialect variation of standard Siamese rather than a distinct language. While the Chinese and Malays keep to their own languages in private, they are educated to use Siamese publicly. Siamese is a tonal language of the Tibeto-Burman type strongly influenced by Pali as a result of long Buddhist missionary activities, and written in a script of Indian origin.

Because the Buddhist tradition is strong, pagoda-type temples have been built in the well-populated zones. Villages have pagodas located outside the house group and not as the nucleus of the settlement, though the religion is integrally associated with social and agricultural life.

It is through the Buddhist priesthood that intellectual life in Siam relates so much to the tradition of the early Indian colonies, an influence which appears also in the traditional Siamese dress, the *panung*, a cloth wrapped round the lower body and through the legs after the manner of the Indian *dhoti*. This dress, common

to Siamese men and women, differs from the *sarong*-like dress of the rest of Southeast Asia and of the hill and jungle people surrounding the Siamese.

Settlement Types.—Village forms resemble those of all Southeast Asia. There are linear villages along levees and similar locations naturally above flood-level, and along the drier edges of the flood plains. Proximity to water is everywhere the chief site consideration. The only landscape of flimsy pioneer type is in the newer commercial rice-farming areas of Lower Siam where tenants are too mobile to concern themselves with formal village construction. House forms are generally raised, built upon bamboo legs, beneath which the simple farm tools and draught cattle are kept. In Korat and in the Western Mountains defensive village forms are more usual, the houses standing in a rough ring surrounded by earthworks and a bamboo stockade; these in part reflect the need for coralling the cattle and also the social insecurity of these remoter areas. Among Laos the word for a town, "*wieng*," meaning a fortified place, emphasises this defensive interest. During the flood season, Siamese cultivators of the lowlands may become water-borne, putting their whole family on small boats until the waters subside. Many houses are in fact built on bamboo rafts, rather like Noahs' arks, and nucleated as villages on the *klongs*, even in Bangkok, where the network of waterways lined by these house-boats has caused it to be described as the Venice of the Far East.

Transport

That North Siam had two-way trading associations with the Shan States and with Burma until 1921 caused Burmese currency to be used there. The anomaly resulted from the difficulty of reaching North Siam from Bangkok on the Chao Praya whose waters and sandbanks vary so much and so quickly. It was a centrifugal tendency increased by the Siamese teak trade being in the hands of those who also held teak concessions in Burma. Burmese, Indian and Chinese traders were at that time dominant in the North. When the Bangkok-Chiengmai railway was built (by 1921) it created a tie, bringing North Siam into the hinterland of Bangkok rather than of Burmese ports. The teak trade continued to use the Chao Praya system seasonally, while the new railway operated for passengers and minor trading goods.

A similar centrifugal tendency existed in the Korat Plateau which has easier routes towards the Mekong (by shallow boats) than towards Central Siam with which the connection was by cattle-caravan. Very little trade went into Korat; the outward movement involved agricultural produce and the cattle carrying it to Bangkok were sold for farmers of Lower Siam. The Ayuthia-Korat Railway, the first major line in Siam, was intended to establish centripetal forces and the line was extended to Ubon more from political motives than because any trade stream was expected. Today this railway brings Korat rice to Bangkok (120,000 tons per annum of poor grade rice which releases better grades for export from Lower Siam), together with cattle and pigs. The inflowing traffic to Korat is very much smaller in volume and value, consisting of a miscellany of fish, sugar and manufactured goods.

The Bangkok-Singapore railway assisted the development of Kra tin and rubber and was also intended to tie this remote southern province closer to the Siamese capital. Its actual flow of freight was small and the movement of rubber and tin by railway from South Kra to Penang has in practice added to the centrifugal tendencies in the isthmus.

Siam is more roadless even than the Philippines. In part this results from the technical difficulties of building roads safe from the Lower Siam floods, in part from a policy of doing nothing to detract from the railway freight. Local freight and passenger movement is largely by the rivers and canals. In 1940 the railways carried well below a million passengers and this was thought to justify not building roads. Southern Siam is without trunk roads and Bangkok road traffic is isolated from the few short roads elsewhere in the country, where they have been built at right angles to the railways as feeders, rather than as routes. Through much of the country bullock caravans are still the only means of land transport.

The Chao Praya system is navigable during high water seasons by steam launches as far as 120 miles above Paknampoh. Thus it carries major traffic inland only for about 260 miles, even in the most favourable season. In the dry season launches can scarcely reach 100 miles from the sea. This is a great contrast with navigation on the Irrawaddy and helps to account for the slower opening up of the Siamese interior. Ships of 1,500 tons can reach

Bangkok but the bulk of rice exports goes out beyond the bar in lighters for loading to the ocean-going steamers offshore.

Towns

The Siamese are not an urban people. They have one large town, *Bangkok*, which is the political, social, economic and commercial capital. Siam may almost be thought of as a city state, because what Bangkok says is acted upon, the isolation of the rest of the country cutting it off from the current of affairs. Bangkok became the capital only in 1782, before which Ayuthia was the principal city with Bangkok merely an outport. The only modernised city in the country, Bangkok is rather isolated from the interior. It is a delta port with the disadvantage of a shallow, winding and variable river across which lie great sandbanks impeding access. The suburb south of the town is industrialised by rice and teak mills. Many Chinese are to be seen on its streets, sign of their prominence in Siam's commercial life. The town has the quality of an advanced artistic tradition, expressed in ornate temples and palaces of distinctive style, often juxtaposed with other buildings of ultra-modern design. Its population in 1947 was 827,000, an increase of 32 per cent since 1937.

Ayuthia, the earlier capital, repeatedly described by 18th century travellers and twice destroyed in Burmo-Siamese wars, has a function in Siam comparable to that of Mandalay. Its transport is principally by river. Though the main railways pass through it, only farmers and shopkeepers live there in a light and flimsy settlement containing less than 20,000 people, many of whom live upon houseboats threading the confusion of creeks surrounding the town.

Chiengmai on the Ping River is the second town of Siam, once important as the capital of a Laos kingdom for which Burmese and Siamese fought frequently. This is evidenced by the elaborate fortifications of what is now a very small country town, focus of the teak industry and entirely dependent upon it now that the cattle caravans into the Shan States and Yunnan no longer operate. Organisation of the teak rafts which go down to Bangkok was done from here.

Political Unity

Siam is unique in Southeast Asia for having remained apart from the pressure of European colonisation going on all round it.

Its independence of an influence so strong throughout this region is more apparent than real since it was originally based on the function of Siam as buffer state between French colonial interests in Indochina and British colonial interests in Burma and Malaya. Thus its independence was tolerated by others rather than maintained by the Siamese and the country was steadily drawn into the process of commercialisation going on round it. Its finances were until 1941 closely linked to British currencies and its trade focused on Singapore. To some extent the strong Chinese influence in its commerce and trade may be considered as having made Siam a Chinese colony in all except the political sense. It has been at home and abroad a very strong influence in Siamese politics this century.

Chapter Nineteen

THE NATURAL LANDSCAPE AND REGIONS OF INDOCHINA

Physiography

Indochina is built round a resistant crystalline Central Massif of great geological age now forming that part of the Chaine Annamitique roughly south of the river Song Buong (Fig. 97). The rocky coast of Annam, a fractured margin of this massif, is part of the northeast edge of the Sunda Platform which may be traced through the South China Sea to North Borneo. Differential movements between this massif and another in South China led to compressional structures between them and the extrusion of igneous rocks. West of the Central Massif, sandstones conceal much of the substructure, signs of which show on roughly north-south arcuate lines from Northern Laos through the Korat Plateau of Siam. Ancient basaltic outpourings mask much of the Central Massif and recent tectonic changes in Tonkin have produced a gorge and plateau landscape.

Between the Central Massif and the Cardamom Mountains and also between the Chaine Annamitique and the South China Massif level expanses of alluvials are still being laid down by the rivers, forming fertile and cultivated lowlands contrasting with the scarcely untouched forests of the crystalline highlands. Limestone occurs extensively to the north, intricately carved by solution processes to produce that bizarre karst landscape of the northern Chaine Annamitique and of the Baie d'Along.

Climate

The climate of Indochina (Fig. 96) is transitional between the influence of continental extremes centring on Asia to the north; and the equability of the archipelagoes to the south, complicated by the changing streams of air described in Chapter 2.

Over the period mid-September to March, continental Asia dominates the meteorology and airstreams from the north and northeast bring low temperatures to Tonkin, rains to the eastern

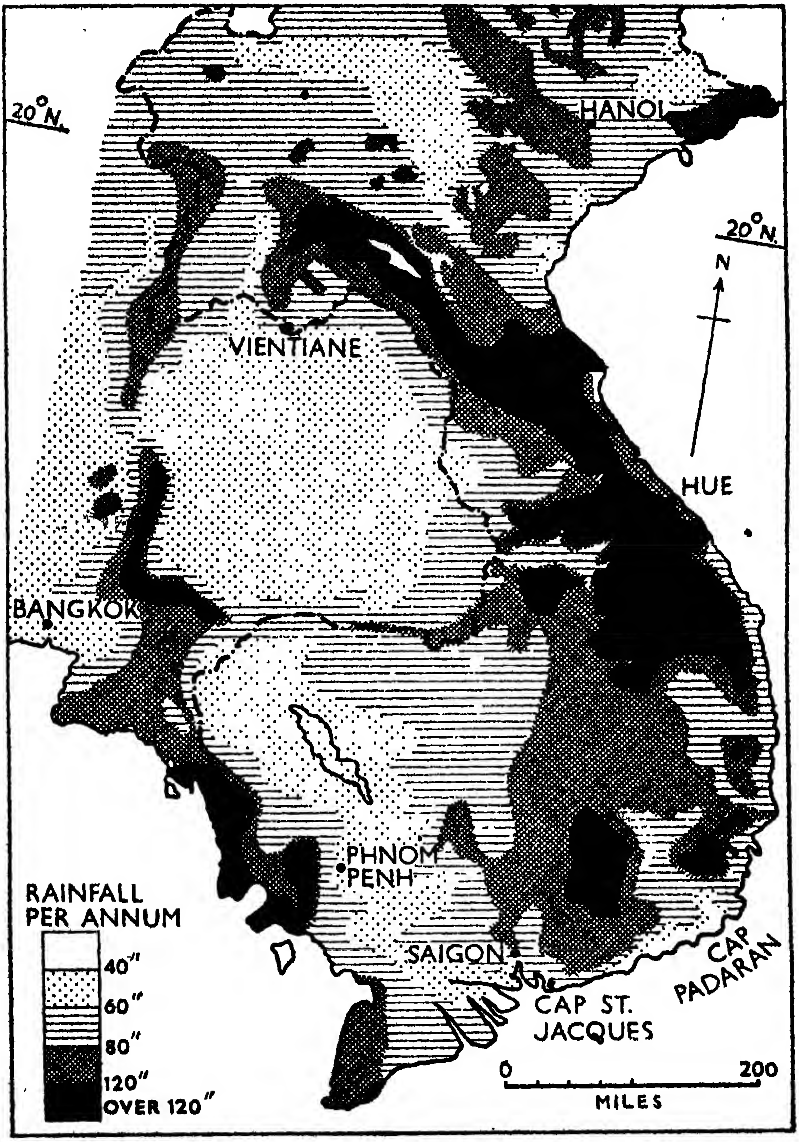

FIG. 96.—Precipitation in Indochina

flanks of the Chaine Annamitique and to the Cardamom Mountains, and dry, sunny weather to the rest of the country.

From June to September, windstreams from the south and southwest bring tropical conditions of warmth and high humidity. Shallow depressions travel from west to east across Tonkin, and a low pressure system often remains over South Indochina for long periods. The whole country at this time experiences its heavy rains, though these do not come with the sudden violence of the Burmese monsoon. Except in the enclosed coastal valleys of the extreme east, Indochina's maximum rains fall in July-August.

Very damaging tropical typhoons sweep across Indochina from the east from July to November, bringing particularly heavy rains to the Middle Annam coast. The average track of these typhoons moves northward from February to mid-August and then southward until January, so that the whole of the east coast from the Mekong to the Chinese border is seasonally exposed to typhoons. During July-September they frequent the coast north of lat. 15°, but during October-November, the danger shifts to South Annam and Cochinchina (Fig. 14).

RAINFALL IN INDOCHINA (inches)

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Hanoi	.9	1.4	1.8	3.7	8.7	10 7	12.8	14 3	10.7	4 1	1.8	1 1	72
Luang Prabang .	.8	.5	1.3	4.5	6.2	6.7	8 9	12.6	6 8	3.2	1.2	3	53
Hue	7.0	3.1	4.1	2.1	4.4	3.2	3.3	4.6	14 4	25 5	29.1	15.2	116
Cap Padaran	.5	.2	.7	.9	3.1	2 5	2.3	1.2	4.1	5.7	6.1	2.7	30
Dalat	.3	1.1	2.2	7.1	8.1	6.4	10.2	8.6	12.7	8.9	3.5	.9	70
Saigon	.7	Nil	6	1.6	8.4	13.7	12.3	11.3	14.1	11.4	4.4	2.5	81
Val d'Emeraude .	1.5	1.7	7 2	8 8	22 4	30.6	41.6	41.5	33.7	19.5	9.9	2.6	221

The average rainfall for all districts is high, with relief causing an accentuated precipitation. The Cardamom Mountains and Ch. Annamitique are zones of highest annual rainfall (over 160 in. p.a.) while the Mekong and Red River plains are comparatively dry (below 60 in. p.a.) and a coastal strip from Phan Thiet to Cap Padaran is the driest zone (30 in. p.a.). Wide variations of rainfall and the uncertainty of its incidence in any one year, complicate the agriculture. These irregularities are greatest to the north, worsened by long sunny seasons of high evaporation which accentuate the drought. Uncertainty of rainfall incidence, a factor fluctuating more here than in other Southeast Asia territories, is

most critical for Indochina rice farming and the crop may fail entirely when the timing of rain or of sunshine is widely irregular. Thus in Indochina a year with a normal rainfall total may prove agriculturally calamitous if one or two critical times of the year are abnormally dry or wet. Rains in Tonkin customarily fall as drizzles (called *crachin*); farther south, they come with more tropical intensity.

Natural Vegetation

Indochina is naturally a forested area of which some 14 per cent has been cleared for agriculture and another 50 per cent modified by cutover to stand now as savannah.

The forest types discussed in Chapter 4 are all represented in Indochina (Fig. 104). Tropical Rain Forest occupies most plains and foothills to 2,500 ft., though lowlands of particularly porous subsoil may have only Monsoon Forest. While rain forest which has scarcely been cut at all remains in the Cardamom Mountains and near Savannakhet, elsewhere shifting cultivation has modified it to secondary forest. The Ch. Annamitique and the Mountains of Tonkin carry Tropical Rain Forest broken by great patches of Monsoon Forest, particularly in the drier uplands adjoining the Middle Mekong Valley. Stands of teak do not develop extensively in the Monsoon Forests except in association with crystalline rocks round Pak Lay in Laos. In Cochinchina and behind Cap Padaran extensive savannah is a response to the low rainfall. Tropical grass (Imperator cylindrica), called "*tranh*" in Indochina and used for thatch, is widespread. Round the Tonle Sap where seasonal inundations occur, the Freshwater Swamp Forest contains many Hydrocarpus or *chaulmoogra* trees whose oil is used for leprosy. The higher altitudes and cooler winters of Western Tonkin Mountains have produced fairly large areas of pine forest, with P. Merkusii and P. Khasya as common types.

Mangrove Forests are restricted to three zones of the coast, the rest being too rocky or too steadily attacked by currents: (*a*) a discontinuous fringe to the Tonkin Delta, (*b*) a continuous fringe to the Mekong Delta, extending northwards into the Gulf of Siam from Pointe de Ca Mau, and (*c*) a fringe round the southern end of the Cardamom Mountains.

On the dunes of bays between the rocky promontories of the Annam coast, are stretches of Casuarina Forest.

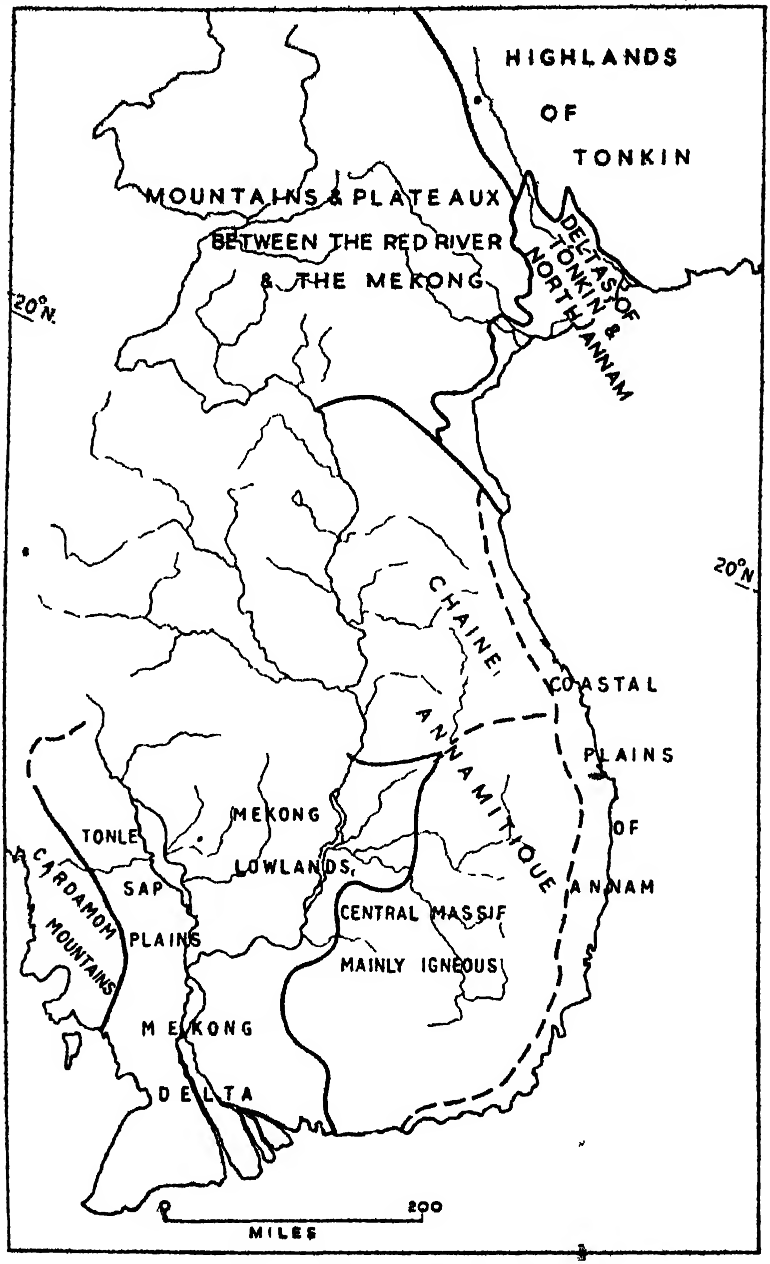

FIG. 97.—Regions of Indochina

Regional Landscapes

Indochina divides into distinctive regions (Fig. 97) which are :—

1. *The Deltas of Tonkin,* including the Red River delta and adjoining deltas of north Annam rivers.
2. *The Lower Mekong and the Tonle Sap plains.*—These regions differ from their surroundings in possessing great population densities (Fig. 102) and large-scale agriculture (Fig. 104), both having served as nurseries for distinctive cultural and communal developments (Fig. 103), though the rhythms of development have differed.
3. *The Highlands of Northern Tonkin,* north of the Red River.
4. *The Mountains and Plateaux between the Mekong and the Red River.*—These are zones of sharp internal contrasts arising from very broken relief in which population is low and scattered and human development has been slight. The Highlands are transitional to South China and through them has been a constant, poorly channelised, coming and going of peoples between Tonkin and Canton. The negative region of mountains and plateaux relates mostly to Northern Siam and Yunnan, and has functioned as a refuge for human groups pressed from the north and from the east.
5. *The Annamite Highlands* or *Chaine Annamitique,* between the Mekong and the South China Sea, is a composite region politically subdivided into Laos, the wild country draining westward to the Mekong, and Annam, centring on small coastal and fertile pockets of intensive agriculture and dense population backed inland by negative uplands.
6. *The Mountains of West Cambodia,* including the Cardamom Mountains and the Elephant Range, an undeveloped and repellent region throughout its known history.

The Tonkin Delta

In Lower Tonkin, the terrain is flat, almost entirely built up of river alluvium (Fig. 98). Minor differences of level on this flat landscape have major significance for agriculture and settlement.

The Red River delta, thickly peopled and intensively cultivated, is edged landward by highlands of rugged limestone. Dunes have been built up on the seaward fringe, and are most developed towards the south. The delta, a large part of it less than 10 ft.

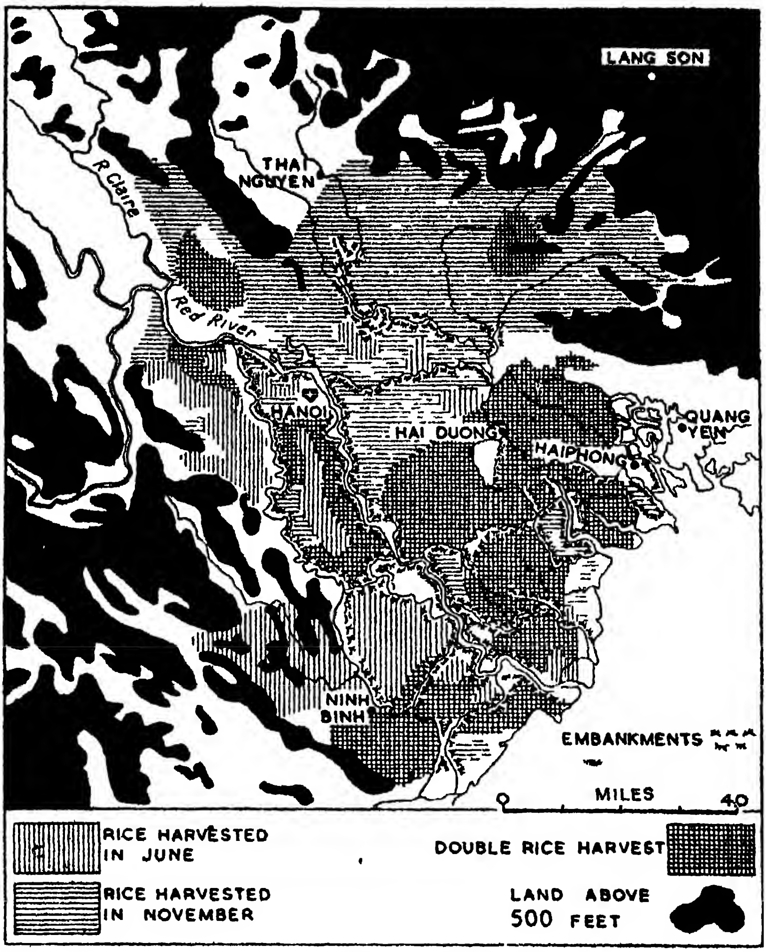

FIG. 98.—The Red River Delta

above sea level, is a network of distributaries carrying off water of the Red River and of many shorter streams, such as the Song Cau, from the Northern Tonkin Highlands. A distinct drift of the main distributaries towards the south has been going on under the influence of heavy sedimentation from these northern tributaries. The deltaic surface merges northwards into deltaic fans built by tributary streams. Numerous embankments, some old terraces and old levees, provide drier and safer zones for settlement and also model the delta surface into shallow basins

which suit the needs of rice cultivators. Towards the north, little of the delta is embanked and tides spread far inland, especially in the dry season when the outflow of fresh river water is least.

Adjoining deltas, the Song Ma, Song Chu and Song Ca, extend the landscape of the Red River delta southward, but the highlands approach closer to the sea and in places isolate parts of this southern alluvial extension, whose agricultural development differs from that of the Red River delta because there is a broken inland

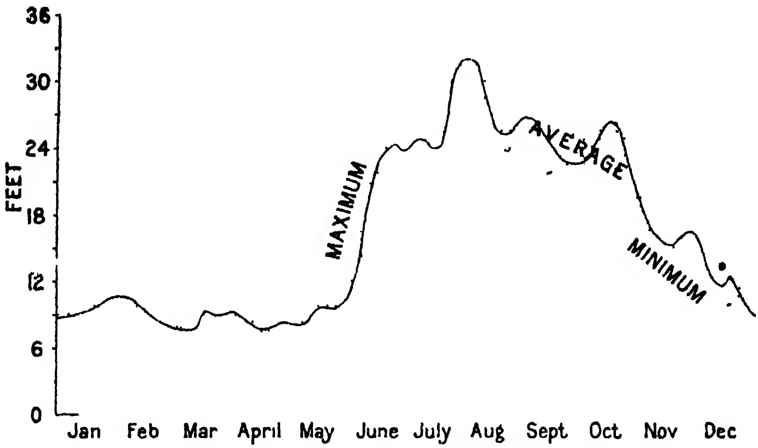

FIG. 99.—Régime of Red River at Hanoi

belt of coarse, sandy soils (probably marine) without natural or artificial embankments to control spates.

The Tonkin and Annam deltas are difficult to approach from the sea and the water channels across them are subject to frequent changes (Fig. 99). These features have impeded overseas trade and make Hanoi and Haiphong not easily accessible by modern shipping. Towards the south, the delta extends seaward at the rate of about 300 ft. a year under the influence of heavy river alluviation and longshore drift.

Upon the delta daily temperatures fluctuate sharply, especially in winter, when temperatures are lower than in any other Indo-chinese lowlands. Rainfall, while showing some seasonal contrasts, is more evenly distributed than farther south, benefiting from South China cyclones in winter and from rain showers brought across the Gulf of Tonkin by the northeast winds. Winter rains come as drizzles (the *crachin*) which have high effectiveness

and make second cropping possible. Annual rain totals are very variable, which, added to wide variations of river flooding, make for unreliability in the rice farming.

Tonkin rice cultivation depends on flood regulation, which has become more difficult following continued deforestation of the surrounding hills, irregular sedimentation and slow migration of the distributaries. Major embankments have been built at various times to control the floods, but have often led to more disastrous floods, as when in 1926 about one-third of the delta was under water following a break in the embankments. As the height of embankments is being progressively increased, the whole river profile tends to rise above the delta level. This admittedly aids the distribution of water to the fields, yet makes more difficult the draining of the inter-embankment basins when once these are flooded.

Modernised irrigation goes on side by side with primitive irrigation. About 2.6 million acres of the delta are under rice; of these 1.2 million acres (in the centre and east) are cultivated during both winter and summer, .6 million acres are harvested only in summer, and .8 million acres only in winter. In response to the great variety of soil, weather and flood conditions from place to place in the delta, over 300 different types of rice are grown, to produce almost 2.2 million tons per annum, with an average yield of 17½ bushels per acre, though it may vary from 37 to 5 bushels per acre in different localities. Of this production less than a tenth goes into trade at Hanoi and Haiphong; the rest is locally consumed by the farmers who are working largely on a subsistence basis. Farms are small; 36 per cent of the cultivated land is in properties of less than 5 acres each, and 27 per cent average between 5 and 10 acres each. One-fifth of farming land is communal and redistributed among individuals of the community every few years, a system in operation particularly on the difficult newer alluvial soils close to the coast.

Through the war years, Tonkin acreages under paddy remained fairly close to prewar figures, indicating the predominant interest in subsistence farming.

The delta carries 9 million people with a rural density averaging 1,400 per square mile which is equivalent to figures in the crowded lowlands of China and Japan (Fig. 102). The urban population is small and only Hanoi, the capital, has over 100,000 people, most

of the other towns containing less than 10,000. Highest rural densities (over 1,500 per square mile) are in districts lining the Red River and in a belt towards the sea, round Hanoi and round Ninh Binh. These concentrations are in the more fertile zones, particularly on newer alluvial soils. To the east and north, delta populations do not reach such great densities, except near Haiphong (70,000), a minor manufacturing town and terminus of a railway into Yunnan. The dense rural population is nucleated for communal help in agricultural work and located where there is some physical security against flood risks. Villages take the form of levee settlements, embankment settlements, sand-dune settlements and groupings round the foot of hills rising above the plains.

The Highlands of Northern Tonkin

A terrain of igneous mountains and plateaux of sandstone or limestone, the Highlands have a pattern aligned from NW. to SE. Through them flow rivers on similar lines, but of varying maturity, most of them having sections of deep narrow gorge. A small portion of the Yangtze drainage system (Song Tso Kiang) carries water northward from the Highlands. Much deforestation has gone on, leaving naked hill landscapes recalling those of South China. Only a thin farming population is scattered through this region, which is chiefly settled by groups of hill people.

Between the Mekong and the Red River

An extensive mountainous area between the Red River and the Mekong reaches greater average heights than the Northern Tonkin Highlands. To the east, this unit has a NW-SE. trend in its relief which is of massive limestone or crystalline rocks forming inaccessible blocks of country. Towards the Mekong the structural trend becomes NE-SW., and involves old sandstone which forms plateaux, such as the Plateau de Tran Ninh, south-east of Luang Prabang. The rivers are here deeply incised in narrow valleys which are infertile, uncultivated and sparsely peopled. The chief stream is the Black River, paralleling the Red River before joining it, and navigable to Cho Bo; despite its rapids this is the artery of local transport.

Both these mountainous regions west and north of the Delta of Tonkin are deeply ravined, generally forested and left to

primitive groups of Laos (or Laotians), Man, Miao and Lolo hill people who have moved in from Yunnan over the centuries. They are stratified in distribution, Laos occupying valley floors and growing wet paddy, and Man groups living at slightly higher altitudes and practising shifting cultivation. Higher still, above 3,000 ft., live the Miao who maintain an energetic mixed hill farming of dry paddy, maize and cattle, and are the militant latecomers to Tonkin. The Lolos are less localised but frequently appear settled beside the Laos.

The population of these highlands totals barely 1¼ million, with a density of 30 per square mile which, while very low compared with the delta populations, exceeds that of other Indochinese uplands. North of the Red River is somewhat more densely populated than to the west, where there are large virtually uninhabited areas.

THE ANNAMITE HIGHLANDS

An extensive region, including the country between the Mekong and the Col de Dong Trai Mit and Cap St. Jacques, and known as the Chaine Annamitique, it is less a chain and more a sequence of weathered plateaux sloping more gently to the west than to the east, where high spurs reach the sea to enclose between them small coastal plains which have been attractive to settlement. From the Song Buong valley northward, the chainlike character is more pronounced as a consequence of the fold-fracture structure involving extensive sandstones and limestones. South of the Song Buong are ancient crystalline masses partially covered by lava flows and flanked to the west by old tabular sandstones leading down to the Middle Mekong and the province of Laos. Upon the basalt lava flows, a laterised soil, called "terres rouges," has proved more fertile than most other upland soils surrounding it.

On the east, the small coastal plains vary considerably in size, fertility and population. They are isolated landwards by broad stretches of negative country edged by abrupt scarps and cliffs and they relate more to the sea than to the mainland. They lack modern harbours and suffer from violent seas which build bars and lagoons across the mouths of the short torrential rivers.

Across the Highlands during midsummer blow the "Winds of Laos," which are föhn winds bringing hot, dry, violent winds to the coastal plains and imperilling agriculture by causing rapid

desiccation. At other seasons the coast induces local variations of climate by shielding certain areas and varying the incidence of land and sea breezes. To these factors attaches special importance because the rainfall in Annam is highly irregular and torrential. The coastal plains are subject to the dangers of typhoons and the risks of local floods because it is difficult to regulate the torrential rivers which frequently have a régime resembling that of the *chaungs* of Burma.

Within the coastal lowlands live 4½ million people in patches of great density associated with the deltas of Song Ma, Song Chu, Song Ca, Huong Giang, Quang Ngai and Quang Nam, separated by virtually unpeopled, barren uplands where only a few nomadic tribes wander. The chief towns are Hue, Tourane and Phan Thiet. Towards Cap Padaran the coastal lowlands contain less people, a result of droughts and greater agricultural risks. These lowlands are almost entirely peopled by Annamites who have steadily migrated southward from the Tonkin deltas.

Over towards the Mekong, population thins out, consisting in the uplands of a group of primitive people derogatively called Moi (savages) by the Annamites. The many tribes of Moi operate interesting transitions between, and combinations of collecting-hunting, shifting cultivation in the forest, and sedentary agriculture. Laos, the state of the Middle Mekong, is peopled by Laotians who are ethnically related to Tais. They live in small agricultural hamlets and have strong Buddhist associations and semi-feudal customs, with a disinterest in mime and dancing, therein differing from Cambodians farther south.

The settlements of Laos are generally along the Mekong itself, with Vientiane, Luang, Prabang, Pakse, Savannakhet and Tha Khek as the largest. The river is the chief line of transport, especially between Savannakhet and Vientiane, but contact with the exterior by way of the Mekong is impeded by rapids, narrows and shifting sandbanks, the signs of an immature river.

Rice occupies 2 million acres of land scattered through the Annamite coastal plains, the larger units being towards the north. Irrigation methods in these plains are primitive. To the north double harvests (June and November) are normal, while farther south, three harvests a year may be gathered, as at Quang Ngai, where harvests occur in April, September and January. About 1 million tons of rice are produced annually, the low yield

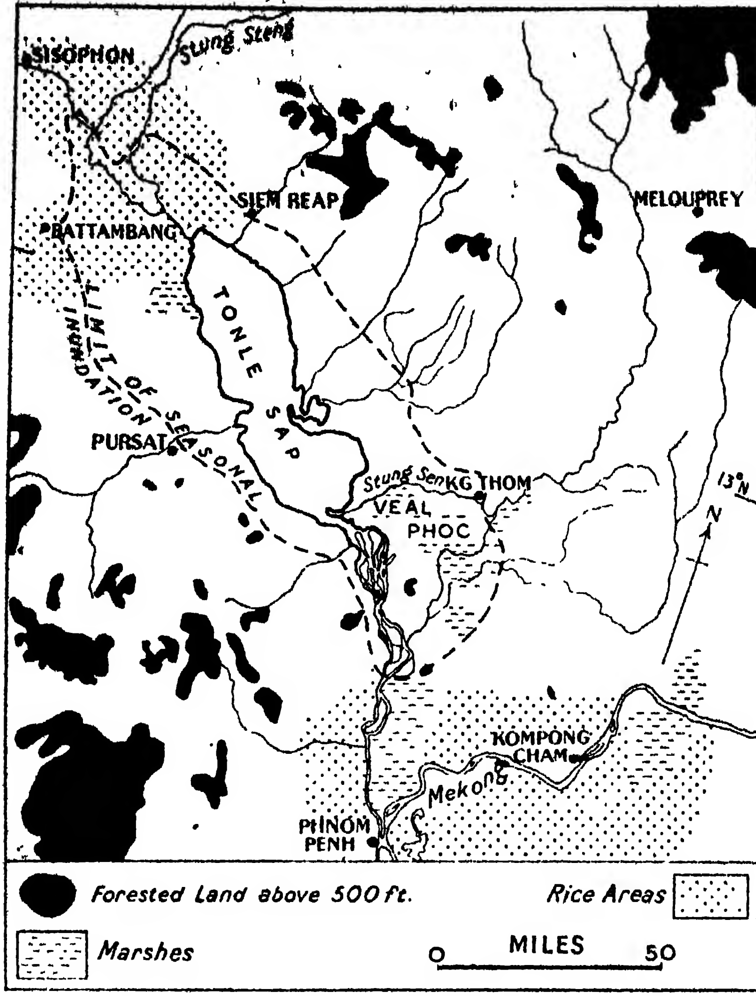

FIG. 100.—Tonle Sap and the Mekong Confluence

arising from soil poverty and irregular rainfall. Salt water fishing is fairly intensive in Annam, a large portion of the catch being salted and converted into the sauce *nuoc mam*, one of the few exportable forms of fish.

THE LOWER MEKONG AND TONLE SAP PLAINS

The plains south of the Phnom Dangrek Hills, Pakse, on the Mekong, and the Plateaux du Muong and Djiring (which end the

Chaine Annamitique), and east of the Cardamom Mountains, have three subdivisions:

(*a*) *The Tonle Sap Alluvial Plain* is one of the most interesting features in Southeast Asia. The area has been converted from an arm of the sea into a plain containing a lake, the Tonle Sap, as the result of Mekong sedimentation which has taken place within probably historic times. The transition was slow enough to retain in the lake fish which are adaptations of marine species. The Tonle Sap (Fig. 100) is shallow (not deeper than 6 ft. anywhere in the dry season) and in process of further subdivision by lacustrine deltas built out by the Stung Sen and Stung Chikreng, and it is blocked at the eastern end by sedimentation which forms the Veal Phoc (Plain of Mud).

The amount of water in the lake varies widely. At low water (November to June) its area is about 1,000 square miles and its breadth 22 miles. Its water then drains to the Lower Mekong across the Veal Phoc through great floating islands of tangled vegetation. At high water (June to October) its area may be 4,000 square miles, its width 65 miles and water flows into it from the Mekong. This reversal of flow at the flood season reflects the fact that the Mekong is so sedimenting its distributaries that it has seasonal difficulty in discharging to the sea. The Tonle Sap thus acts as safety valve for the Mekong, probably explaining the low flood risk in the Mekong Delta, which needs no embanking such as is essential in Tonkin.

(*b*) Through the lowland east of Tonle Sap, the Mekong continues a southward course as an elaborately braided stream over flat clay lowlands above which small sandstone outliers rise as low hills, as near Khone. Rapids in the Mekong below Khone are caused by an east-west belt of basalt and there are minor obstacles of similar type near Kratie.

(*c*) *The Mekong Delta* may be considered to begin from Phnom Penh (Fig. 101) where the Tonle Sap outflow joins the Mekong and the whole river divides into two major distributaries, the Fleuve Anterieur and the Fleuve Posterieur, which in turn subdivide before reaching the sea. The delta merges and is continuous with the Vaico-Saigon deltas on the north which are less fertile and less populated. The whole is built of sticky

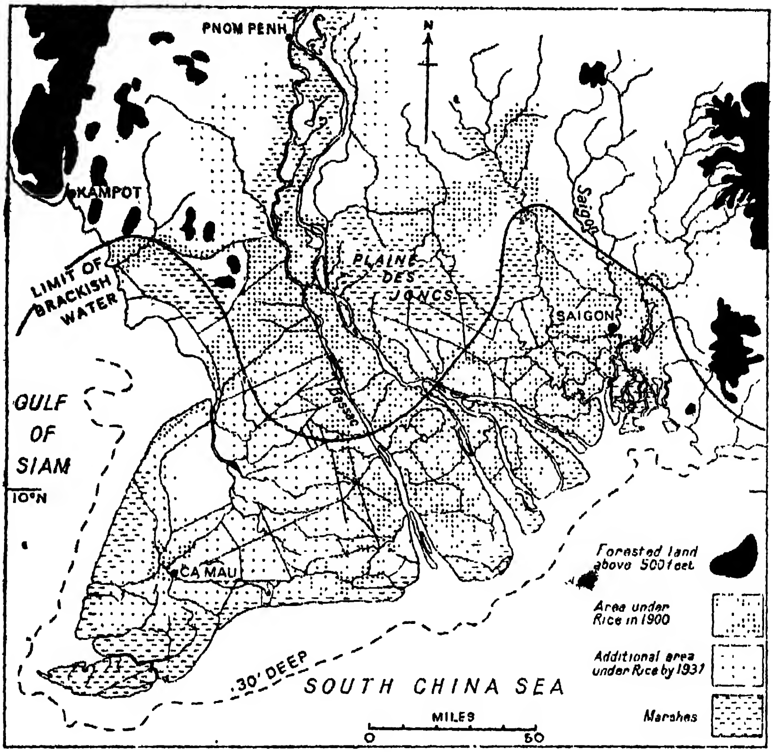

FIG. 101.—The Mekong Delta

mud with occasional belts of fluvial sands. Except at the mouth of the Saigon River, the delta's coast is not approachable by major shipping and the distributaries are unnavigable except for very small boats. The Ca Mau Peninsula (Presqu'ile de Ca Mau) is a gigantic spit, built from Mekong materials carried southeast by marine currents. It is extensively forested and advancing seaward at 200 ft. a year, so that charts of it are unreliable.

Cambodia roughly consists of (*a*) and (*b*), whereas most of Cochinchina is (*c*).

On the Mekong Delta, a midsummer drop of the otherwise high temperature is caused by rains which here derive from southerly winds in a monsoon régime; at Saigon 76 in. of rain fall from April to December (with peaks in June and September) and only 4 in. during the rest of the year.

The delta floods resemble those of Lower Siam. Cultivation depends entirely on the natural flood rhythm and there is practically no controlled irrigation. At Bathé, for example, on the border of Rachgia and Long Xuyen, from October to January the Mekong is flooding its delta to depths from 18 in. to 6 ft.; during July and August the delta is flooded by local rains. For these conditions, "floating rice" was devised and introduced at the end of the eighteenth century, an innovation which alone made possible the great increase of paddyland on the delta this century. "Floating paddy" is sown (without using a seed-bed) in the dry period of March and left to grow through the river-floods for harvesting in January when they subside. Strains of this paddy may have stalks as long as 18 ft., which permit the plant to continue growing through floods which would drown normal types of paddy.

Of the population of this whole lowland, about 4.6 million are in the Cochinchina portion and only 3 million in the much larger Cambodian portion (Fig. 102). In the former, the average rural density is about 150 and in the latter 40 per square mile. In the Mekong Delta itself densities reach 250 per square mile, far below those for the Tonkin Delta, an interesting contrast between two deltaic regions of similar climate and agriculture. The explanation lies in the physiography of the Mekong Delta which has been the scene of faster deposition and more dangerous inundations (comparable with the Chao Praya floods) than the technology of earlier Cambodians could deal with. The Indian colonial period here is fairly well documented: at that time interest centred round what is now the Tonle Sap, more particularly at Angkor on the line of overland routes into Siam, an area where there appears to have been prolonged social disruption by disease and flood. The parts of the delta most densely populated and intensively cultivated today are those where Annamites have immigrated from seaward, more recently, causing population to increase very rapidly this century.

Though elsewhere generally rural, the population of the lowlands is urbanised at Saigon and Cholon, twin towns on the north-east margin, whose combined population totals about a quarter of a million people. These twin towns are not upon any Mekong distributary, but on the Vaico and Saigon Rivers, though these are linked by old channels to the Mekong and their deltas are

continuous with those of the Mekong. Thus Saigon has a site value relative to the Mekong similar to that of Rangoon and the Irrawaddy.

Where the deltaic soils are specially fertile and water control has been developed for paddy cultivation, new populations have settled ; towards the coast the population thins, where tides make the subsurface water brackish and prejudice farming. Away from the distributaries, on the interfluves or mesopotamia, the population also thins out. Distinct linear patterns of settlement along the river banks and along the lobate lines of old dunes, now well inland from the sea, are apparent throughout the delta.

In the Cambodian plains, densest population spreads across the lowlands from the Cochinchina border towards Kompong Chhnang and Kompong Cham. Phnom Penh, the state capital, is fairly central to this lowland though eccentric to the state as a whole. Population round Tonle Sap is confined to a narrow band between the marshes bordering the lake and the forested hills. Most villages are above the limit of summer floods and therefore well away from the lake itself, though some pile villages have grown up close to it. Angkor, the ancient capital near the country town of Siem Reap, lies well north from the lake today, though its old importance probably hinged upon waterside location during the Indian colonial period. Battambang, second town of Cambodia, lies far south of the lake on a well cultivated lowland now connected by rail to Phnom Penh.

In Cochinchina 5.5 million acres were under rice prewar, as were a further 2 million acres round Tonle Sap and its adjoining Cambodian lowlands. This cultivated area had increased four times since about 1875 and rice monopolised it more than anywhere else in Indochina, though the farming was much less intensive than in Tonkin. On the delta zone, where the rice pioneers have been most active and effective, the yield averages about 10½ cwts. per acre; characteristic of the landscape are special granaries for storing that rice which is paid as rent-in-kind by the tenant farmers. A variety of floating paddy is grown in the fields liable to specially deep floods round Tonle Sap. About 3 million tons of rice are normally produced on the delta with another .9 million tons from Cambodia. The former is derived from compact holdings averaging 22 acres each held on a system by which the tenant halves the harvest with the landlord. In Cambodia 80 per cent of the

holdings are less than 13 acres and for the most part owner cultivated.

The agricultural situation arising from the Second World War differed from most parts of the region in being more affected by postwar disturbances than by wartime expediencies. While acreages under rice remained well up to prewar average in Cambodia, in Cochinchina they declined by nearly half in 1946-47, reflecting the delta's greater concern with rice as an article of trade.

The second activity is fishing in the Tonle Sap which produces tremendous quantities of fish, equalling the total sea fisheries of Indochina. The fish are dried, smoked or fermented for export from the region by junks which move out of the lake to the Mekong by way of the Snoc Trou or mud flats. In many places the junks must be pushed through mud and vegetation rather than floated in the ordinary sense, taking 15 days to reach Phnom Penh from Kompong Luong. There is a sea-fishing industry round the Mekong Delta where the river discharge contains much food for fish.

Saigon, chief port of South Indochina, is on a river accessible by seagoing vessels of 27 ft. draught despite the shifting bars and curves which make it an awkward entry. These defects are aggravated by the port being located off the main lines of Southeast Asia shipping routes. Very much a French town in atmosphere and layout, Saigon's trade and industry centres on rice; practically the whole of Indochina's export of rice passes through this port and its mills. Its general trade, apart from the rice export which moved characteristically to ports elsewhere in Asia, was closely linked to France until 1940.

The isolated *Mountains of West Cambodia*, the Cardamom and Elephant Mountains, resemble an island surrounded on the one side by the Gulf of Siam, and on the other by the fertile Mekong lowlands and their extensions westward to Lower Siam. Densely forested and very rainy, the Cardamom Mountains are the highest points of a plateau over 3,000 ft. high, a little known area of crystalline and calcareous rocks with short, violent and deeply entrenched rivers. Its coast is lined with miles of inaccessible cliff, broken by low-lying estuaries supporting isolated farmers. The zone is negative, isolated and very thinly peopled.

Chapter Twenty

THE CULTURAL AND SOCIAL LANDSCAPE OF INDOCHINA

The Population Pattern

Indochina has an average population density of over 200 per square mile, greater than that of Siam and Burma, yet scarcely 8 per cent of the country is cultivated and settled. Large areas are virtually unpopulated, leaving the agricultural areas with densities of over 1,000 per square mile, thus repeating the Southeast Asia pattern of congestions and empty spaces standing side by side (Fig. 102).

The empty spaces of Indochina are repugnant to people of the crowded coasts and deltas because the forests and mountains are considered to have endemic malaria from which the lowlands are relatively free. The malaria of these forests has not only prevented permanent internal colonisation in modern times, but also undermined the stamina of people already settled there and is thought to have diminished their natural reproduction. The barrier of malarial forests largely accounts for the greater success of coastwise migrations into Southeast Asia from the north, as compared with overland movements which have petered out in the last century or so. The rise and fall of historic kingdoms in Southern Indochina may also be related to this disease factor, which has discouraged population in the uplands. No doubt there has been a slow expansion of highland people, suggested by the rapid silting up of the lowlands in modern times, but the net effect has been unfavourable to the uplands.

Of 24 million (1947) people, over 72 per cent are Annamites, most of whom live outside the state of Annam, and 13 per cent are Cambodians. The other large groups are : 1.3 million Laotians (in Laos and Cambodia) and about 1 million Mois in the mountains. The chief non-indigenous peoples are the Chinese of Southern Indochina towns. Three-quarters of the total population is rural and the total urban population in 1936 was only

about a million, shared between the towns of Hanoi, Saigon, Cholon and Phnom Penh.

Because the population is rural and dependent both for income and for subsistence on the one crop, rice, the people are largely concentrated in the rice-growing areas. The ratio of population to rice areas, the "nutrition density," is thus more relevant than the ratio of population to state areas. There are fairly wide variations of nutrition density state by state. Many districts have far greater nutritional densities than those of the state as a whole. Cua Bang, for example, is a Tonkin province with a nutrition density of eight per acre!

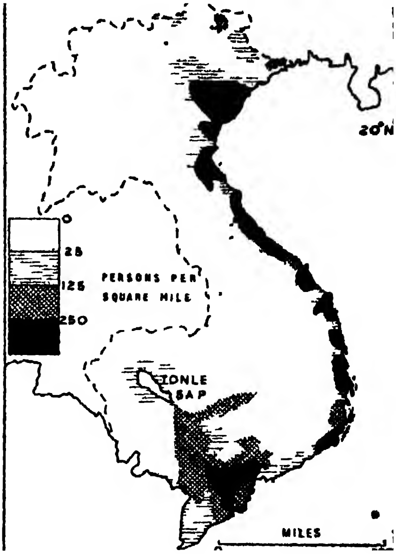

Fig. 102.—Density of Population in Indochina

Population pressure is clearly most acute in Tonkin and the Annamite lowlands and least in the Mekong Valley.

INDOCHINA: NUTRITION DENSITIES BY STATES

	Persons per acre of paddy (1941–46)
Annam	2 5
Cambodia	1.2
Cochinchina	1.0
Laos	9
Tonkin	2.6

Reliable censuses began only in 1906, since when the Indochinese population as a whole has increased by about 1.2 per cent per annum, a rate fairly constant throughout the country at the present time. Thus Indochina has added another 75 per cent to its population during the course of this century.

The contrast in population density between the crowded alluvial lowlands and the thinly peopled uplands reflects differences

in agricultural potentiality, differences in outlook, and different forms of land utilisation. The Annamites in the deltaic lowlands round the Red River have grappled with the difficult conditions there and acquired a reputation as hardworking farmers; the Mekong lowlands, originally developed without continued success by Cambodians and Laotians, later received large numbers of Annamites who settled and coped satisfactorily with the Mekong paddylands, which thus were some of the last in Southeast Asia to be brought into production. Why Cambodians should thus have lagged behind other communities in agricultural initiative is not easily determined, especially in view of their historic importance, of which we have evidence at Angkor. It is probably less an inherent defect of Cambodians and more a combination of progressive debility, high disease rates and a long series of Mekong inundations which for a period were beyond control by the techniques available.

Migration

Migration in Indochina has assumed several forms. When the agricultural potentialities of the Mekong Delta began to be realised early this century, large numbers of Chinese from South China and Hainan immigrated to take up land, and later to specialise in trade along the inland waterways. Few of these farm immigrants are still agriculturists. The Chinese community has fluctuated with the state of trade, although local nationalism in modern times has put a brake upon it, but Chinese are important as rice dealers (recalling the situation in Siam), rural money-lenders, fish dealers and middlemen. Until 1941, Chinese were continuing to immigrate into Southern Indochina. The total in Indochina as a whole was 293,000 in 1912, 400,000 in 1926 and 326,000 in 1936.

More significant, though less easy to analyse in detail from statistics available, has been the migration of Annamites from overcrowded Tonkin and Annam to the Lower Mekong. Transport difficulties hindered the movement of Annamite peasants, who in addition have an aversion to leaving their traditions and their home fields, however congested. They moved on short contracts to plantations in the hill zones, but they avoided the mosquito-infested forested areas when they sought permanent settlement. Despite these factors, about 4 million Annamites now

live in the paddylands of Cochinchina, the result less of recent events and more of that steady southward drift of Annamites which has been going on since the 14th century, and has gone on irrespective of the French conquest and the development of local politics. Only figures for contract-labourers are available, and of these 10,000 Annamites moved into South Indochina each year so that the population balance of the country as a whole has been steadily changing, however small the movement in proportion to the congested population of the north.

Ethnic Groups

In Indochina is found again the contact between earlier people of Indian and Far Eastern origin who have left influences in culture, religion and language (Fig. 103). The old Hindu tradition centres in Cambodia and the Chinese tradition in Tonkin, so that the two major population foci, the Mekong and the Red River lowlands, differ ethnically; the areas between are zones of interaction between these peoples and the migrant hill people at different stages of development, who are partly wanderers overland from the north and partly refugees from the lowlands. Thus Indochina's physiographic differences are paralleled by different population densities and differing ethnic groups, and the impediment of the Chaine Annamitique has served at once to separate the major groups and to conserve a few hill peoples.

Among the peoples we may distinguish two distinct types:

1. The South Mongoloid people, fairly short, bracycephalic, with short flattened nose, straight black hair, the epicanthic eye and a yellowish-brown skin. Annamites often show these features clearly, retaining their slight build even after considerable intermingling with other types. The Laos of the Middle Mekong Valley are of this Mongoloid group which has spread south and east from Tibet and Siam (see also Fig. 62).
2. A short, long-headed, moderately broad-nosed people with wavy black hair and straight eyes is a type widespread in the East Indies and represented here by the Cambodians who, while mostly a cross between South Indian colonists and Mongoloids, are smaller, darker and better built people than Annamites. The physical types among the Mois, in Laos particularly, are generally Nesiot, though many hill groups relate to woolly-haired Negritos.

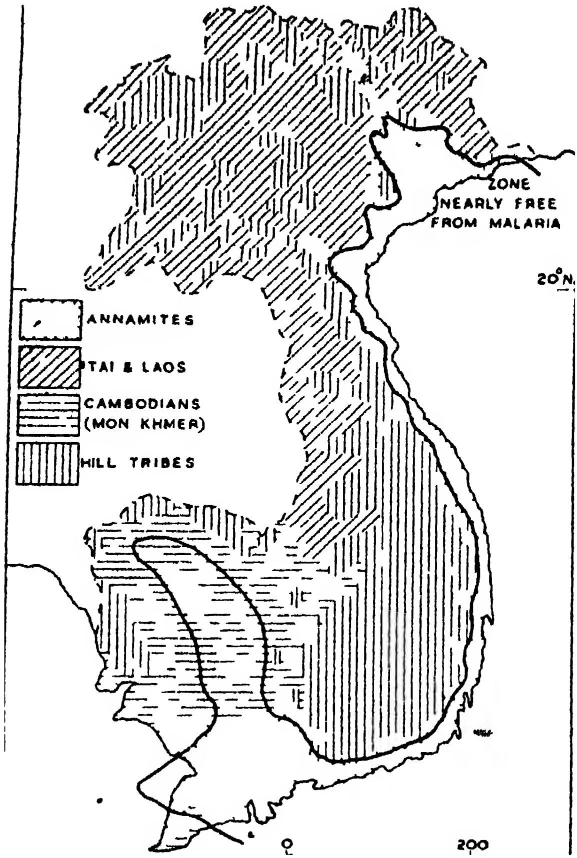

FIG. 103 —Ethnic Distributions in Indochina

These physical distinctions between North and South Indochina are emphasised by language (Fig. 118). The Tonkinese and Annamites have monosyllabic tonal languages, related to Cantonese, once ideographic and now rendered into a romanised form. Southern and western parts of Indochina use Cambodian or Khmer languages, which have no tones, are polysyllabic and written in a derivative of a South Indian script; Tai, used close to the Siamese border, while tonal, has many Cambodian roots. The hill peoples speak languages allied with Malay, Burmese and

Tibetan, and many almost extinct languages are preserved among them.

Indochinese Agricultural Types

Agriculture in Indochina is generally of the subsistence type, direct consumption of home-grown produce limits the circulation of commodities and of money among the peasants. Plantation agriculture, under European direction, has developed only this century and the area involved is less than 1 million acres as compared with 14 million acres of indigenous cultivation, and Indochina's total area of 185 million acres. The indigenous agriculture concentrates in the lowlands, the plantations in the uplands, more especially in the more fertile "terres rouges" over laterised basic lavas in the southern Chaine Annamitique.

The Tonkin and Mekong Deltas are the key farming areas, with small but well-cultivated patches in the innumerable small coastal basins of Annam. The Tonkin Delta has been built up of alluvial loams, sands and clays in proportions varying from place to place. North of the Red River and west of Hai Duong the alluvium is sandy, elsewhere a loam of red, yellow or grey colour predominates. These soils are laterised, accounting for the tendency to bake hard when left bare for a time. Cultivation and repeated flooding by the heavily silted Red River seems to be stemming the worst effects of laterisation, enabling soil fertility to be maintained despite very heavy cropping. In Cochinchina the most fertile areas are of recent Mekong alluvium which has a high nitrogen and potassium content but is deficient in lime and phosphorus. Certain alluvials round Saigon appear to have suffered podsolisation, to become infertile sandy grey earths not suited for agriculture.

Three types of indigenous land utilisation (Fig. 104) have grown up in different regions:

(*a*) Coastal plains to the east as far south as Binh Dinh are intensely cultivated with two or three crops each year, on a subsistence basis with negligible trade in agricultural products.

(*b*) On the plains of the Lower Mekong and Tonle Sap, land is farmed more extensively. Only one crop is usually obtained each year and much potential farmland remains unused. From this zone of relatively low population, a considerable surplus

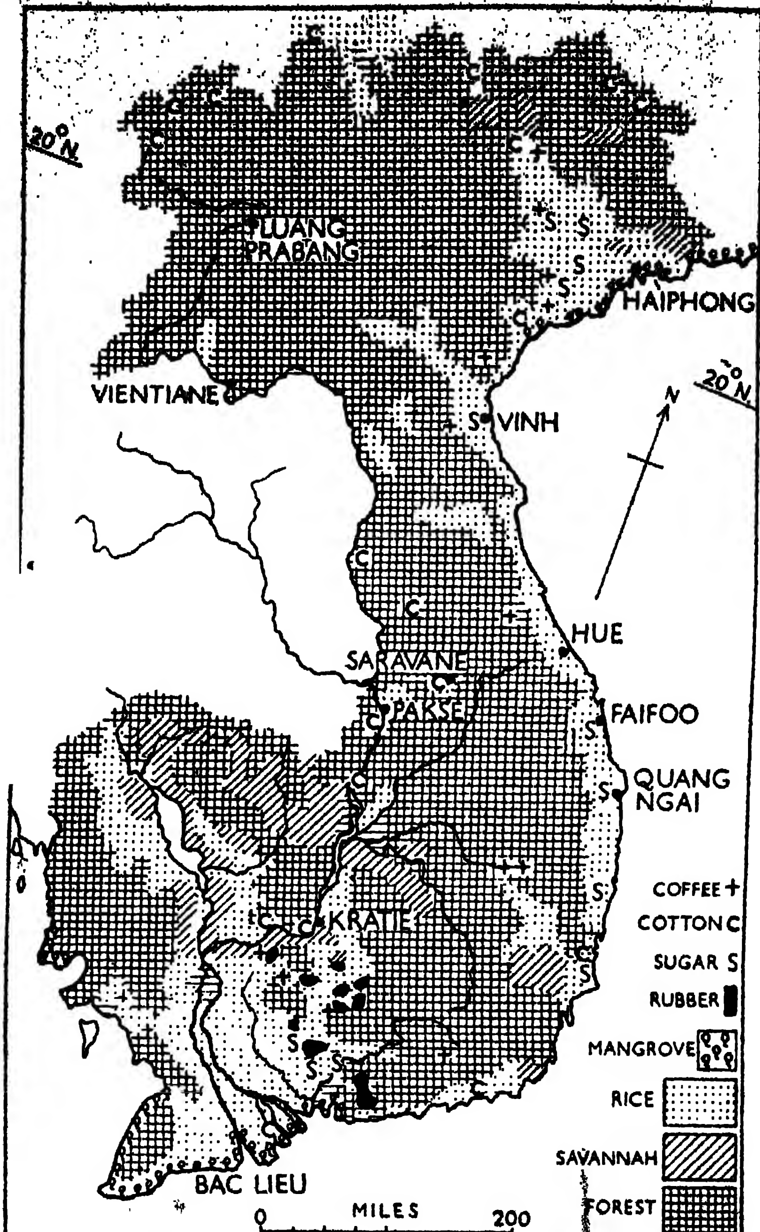

Fig. 104.—Land Use in Indochina

of rice is produced for trade, forming the chief source of Indochinese rice exports.

(*c*) In the jungles, the hill tribes follow the self-sufficing system of shifting cultivation.

The human ecology of rice shows clearest in the older, more intensive agricultural districts of Tonkin and Annam, where personal or family farming (as opposed to tenant farming) and seasonal communal co-operation is customary. There the peasant has a small thatched wooden house, stilted for security and nucleated into small hamlets (an isolated farmhouse is unusual) but at the same time close to his small fields. A few fowls and pigs are his only livestock and produce little cash income. On an average, individual peasants do not own buffaloes or oxen, but a group of them shares one animal for ploughing. The simple farming tools are everywhere home-made, almost entirely of wood, for rural Indochina is still largely in "the Wood Age."

To illustrate how self-sufficing the system is, Gourou took samples in 1934 which showed that the net cash receipts of the Tonkin farmer averaged only $32 per annum. It is to be understood that such farms produced enough rice for home consumption and this cash represented all that was available for sale off the farm after subsistence needs had been met.

In Cochinchina, the most recently developed rice-growing region, large personal holdings of land were staked out before development began, so that cultivation through tenant farmers is the usual practice. Peasants find it difficult to obtain suitable virgin land and a floating labouring population exists, often made up of those who need wages to send back money to families in northern Indochina. The usual tenant family rents 12 to 25 acres of paddyland on which all members must help. The tenant pays 50 per cent of the crop as rent in kind, consumes most of the balance in his own family, and goes as wage earner for short periods to obtain a margin of cash which the sale of the excess rice is insufficient to produce for him. Cochinchinese tenant farmers have annual cash receipts averaging $75-100.

In all parts of Indochina the farmers become involved with moneylenders, who are often the Chinese merchants upon whom the peasant depends for selling rice and purchasing his other needs, as has been the case with Burmese peasants.

Of the 15 million acres cultivated (1940), 12½ million acres

were under paddy, which provided about 6 million tons of cleaned rice, supplying 90 per cent of the Indochinese diet and 70 per cent of the exports. The whole rhythm of rural life centred on rice, which set the pace also for general commercial activity. The margin of rice exported, 1.3 million tons per annum for 1936–40, was only about 20 per cent of the annual production, so that given normal wide fluctuations of climate, yield and price, Indochinese commerce depended on a narrow margin.

As a result of postwar dislocations rather than of the war itself, the rice export declined to a nominal 90,000 tons for 1950. There is no reason to suppose that paddy acreages throughout Indochina have decreased as spectacularly. Over the period 1941–48 about 4.5 million acres went out of cultivation in South Indochina (cf. 3 million in South Burma, Chapter 10).

Maize has been introduced as a supplementary crop on paddy-lands for years when the rice crop is below normal. Although supported by preferential tariffs on the French market, maize made little headway as a crop though very widely grown and fairly prominent in the export trade with France.

Tropical root crops (sweet potatoes and yams) and tropical fruits are grown as dry season crops in small patches, generally for home use. The limit of coconut cultivation is in middle Annam, northwards of which winter temperatures are too low. Extensive coconut plantations have been located near Bong Son, Binh Dinh, Faifoo, Quang Ngai, My Tho, Ben Tre and Vinh Long. Groundnuts were grown in the Tonkin Delta but vegetable oils entered little into trade, because of competition with vegetable oils in other French territories and of the French home preference for olive oil in domestic use.

A quick-growing dwarf mulberry pecular to Indochina is often grown in combination with rice round Hai Duong in Tonkin, and Thanh Hoa, Quang Nam and Binh Dinh in Annam, for feeding silkworms as a cottage industry. The quality of silk has not been good or cheap enough for the European market, but some went to Siam's cottage weavers. Cotton cultivation was tried in Thanh Hoa and in Cambodia, but never produced enough for local needs; the crop does not attract peasants because of its poor return, although climate, soil and rural conditions otherwise suit the plant.

Sugar is grown as a peasant crop, occupying just over 100,000

acres, of which the majority is in Annam (the Quang Ngai-Phu Yen lowland) and east Cochinchina (particularly in the Vaico Oriental, Saigon and Dong Nai Valleys). The crop is carelessly processed and therefore gives a poor yield so that the total production of sugar is less than the peasant consumption.

The well-populated districts of Nam Dinh in Tonkin, Tourane-Faifoo in Annam, and Gia Dinh, Hoc Mon and Kompong Cham in the Mekong lowlands cultivate poor quality tobacco, which needs considerable labour and forms a dry-season cash crop for peasants, although it is unsuitable for export.

Indochina has been the world's second largest pepper producer. Characteristically a product of Chinese cultivators, on the Kampot plains of Cambodia, the crop hitherto went almost entirely to France.

Plantation agriculture was started in Indochina as part of the colonial system and concentrated mainly along the Saigon River and the Dong Nai in Cochinchina, in the "terres rouges" districts, near Kompong Cham in Cambodia, and scattered through Laos and north Annam. Of the large plantation holdings by Frenchmen, nearly two-thirds were under paddy and sublet to tenant farmers, a condition unparalleled in any other Southeast Asia colonial territory; the rest was in rubber, coffee and tea.

Indochinese rubber plantations appeared later than those elsewhere in Southeast Asia, totalling in 1940 less than 150,000 acres spread over 350 plantations, mostly in eastern Cochinchina and Cambodia. Producing about 52,000 tons in 1950, the industry had to be repeatedly state-supported and was primarily related to the tariff-protected market of France, rather than to the world market.

Coffee, one of the earliest plantation enterprises, has ceased to be important in Indochina. Begun originally in the hills near Phu Ly, cultivation rapidly shifted south as soil became exhausted, to small estates on the "terres rouges" of Central and South Annam, near Vinh, Quang Tri and on the Plateaux of Darlac and Lang Bian. Only a small proportion of the 1,500 tons of coffee produced went into export.

Political Units

Indochina as a unit was a creation of French administrators who exercised a single political control over the different physical, economic and human regions which were divided into the following

administrative units, whose modern names show that they are evolved from historic political units:

1. *Cochinchina*, which became a French colony in 1862, was previously an outlier of the Empire of Annam, and never before a unit on its own. There is little correlation between Cochinchina and its physical setting—the seaward fringe of the Mekong Delta—and it is populated by Annamites.
2. *Cambodia*, a kingdom which began as a Hindu colony, is centred in the Tonle Sap-Lower Mekong agricultural area and was much used in earlier times as an overland route between west and east.
3. *Annam* was a historic unit, under its own emperor, and has been militantly expanding southward since the 14th century.
4. *Tonkin* was also an "Empire" which had for long been under Chinese suzerainty. Its conquest by the French in 1884 was in effect a Sino-French conflict and later the "empire" became the focus of Indochinese nationalism and "Viet Nam."
5. *Laos* was originally a group of small principalities pulled politically between Annam and Siam.

The units constituted "The Union of Indochina," in which Cochinchina was a French colony and the other units French protectorates under a Governor-General in Saigon. The political centre of gravity had previously been well to the north in Hanoi as opposed to the first millenium centre on Tonle Sap. The French established a new focus, serving to emphasise the divergent outlook between the north (the Annamite area, base of the Viet Nam movement) and the south (the Cambodian area). The political units relate to the geographical pattern: Tonkin is roughly the Red River Delta, Annam is shut in between the negative Chaine Annamitique and the South China Sea, Cochinchina is a conventionally-bounded fringe to the broad Mekong lowlands which as a whole form Cambodia. The unity instituted by the French is planned to continue as a federation of four states.

Industries

Mining industries have been developed on western lines and peasant industries are limited to small-scale production by village or cottage workers of pottery, cotton textiles, basket-work and woodwork for domestic use.

Of the worked minerals, coal, and tin with its tungsten associate,

have been by far the most important, valued at 63 per cent and 29 per cent respectively of the total Indochina mining production of $9.5 million (1937).

Coal was mined almost entirely from the Quang Yen field which stretches in a fairly large arc close to the coast north of the Red River. Close to the surface and fairly horizontally bedded, the coal, of anthracitic, smokeless and high calorific type, was first mined opencast. As mining moved east into descending strata, shaft systems became necessary. Capable of about 2½ million tons per annum, the fields have the advantages of accessibility, proximity to shipping and the best type of coal in all Southeast Asia, where coal deposits of any kind are few. There are small inland extensions of coal at Tuyen Quang and Phan Me, where production has never been significant, which was also the case at the small field of Nong Son in Central Annam. Total production in 1950 was .48 million tons (cf. 2.3 million tons in 1938).

Tin came into production very recently in Indochina, to achieve an annual output of 1,500 tons by 1940. It was produced at two centres—which together produced only 60 tons in 1950:

(*a*) Near Cao Bang in the Pia Ouac Massif of Tonkin, close to the Chinese border, as an outlier of the Yunnan tin-fields. Here the lode tin, which is associated with wolfram, produced about 40 per cent of the Indochina output and went by way of Haiphong to Singapore for smelting.

(*b*) Near Nam Patene in Laos, close to the Mekong, a basin of alluvial tin has been mined, to produce 60 per cent of Indochina's tin. Sulphurous and ferruginous minerals associated with Nam Patene cassiterite make it less simple to smelt. The ore travelled down the Mekong for export to Singapore smelters.

Zinc had been produced in widely fluctuating volume at Cho Dien in Tonkin, but difficulties of production, transport and varying demand operated against it. Small quantities of silver, lead, antimony, iron ore (from Kompong Thom in Cambodia and Thai Nguyen in Tonkin), gold, phosphates and precious stones have also been produced but have little significance as a whole.

Communications and Trade

The road pattern consists of a fan of roads round Hanoi, another opening through the Mekong lowlands from Saigon, and the two

linked by a coast road through Annam. The road from Saigon along the Mekong is only seasonally usable throughout its length to Vientiane.

The railway system is more sketchy, though designed to establish cohesion between the northern and southern zones of population and production. The main line runs between Saigon and Hanoi, keeping close to the east coast. A separate line from Phnom Penh to Mongkol Borey provides an isolated system intended to link Cambodia to the lower Mekong river shipping and avoid the mud flats below Tonle Sap. From Haiphong and Hanoi a railway has overcome considerable relief difficulties to run northwest into Yunnan as far as Kunming, the only railway to inner China. It was always a restricted service, carrying scarcely 300,000 tons of freight per annum in prewar times.

The external routes are shipping lines to Saigon, a few local shipping services to Haiphong and an airline linking Saigon to Bangkok, Singapore and Hongkong. A considerable coastwise shipping goes on, linking the population centres of Annam and taking part in trade with Siam and South China.

Indochina is primarily an exporter of agricultural produce of low value in proportion to weight. Of the total exports in 1950, valued at $210 million, rice formed 20 per cent, rubber 50 per cent and maize 4 per cent. The last two items went primarily to France, the rice to China, Japan, the East Indies and France in that order of value.

Its imports are mainly processed goods, generally few and costly. Of the 1950 imports, valued at nearly $700 million, 28 per cent were textiles and fibres, 25 per cent were metals and machinery, of French origin.

Indochina's total trade after the war was 10 per cent with the Far East, largely with China, 10 per cent with U.S., and 60 per cent with France. Rice, rubber and tin went into trade at Singapore, entrepôt for the rice consuming and tin and rubber producing territories of Southeast Asia.

Chapter Twenty-one

THE PHILIPPINE ISLANDS

Physiography

Eleven islands, Luzon, Mindanao, Samar, Negros, Palawan, Panay, Mindoro, Leyte, Cebu, Bohol and Masbate, in that order of size, account for 95 per cent of land area in the Philippines. The other 7,000 islands of the group are mostly a few rocks or corals showing above the sea, with areas of less than one square mile each. Themselves separated from the Asiatic mainland by deep seas, the Philippines are flanked to the east by one of the world's profound oceanic trenches (over 7 miles deep) and they form part of the "fiery girdle" of volcanoes, earthquakes and tectonic instability, which rim the Pacific on meridional lines. A knot of different structural lines sets the pattern of these islands. Through Luzon, Samar, Leyte and Mindanao distinct N-S. fold-fault systems are apparent in continuation of that line of structures paralleling the eastern edge of the Sunda Platform. To complicate the physiography, volcanoes and their ejecta dominate the landscape from the south as far as the southern peninsula of Luzon, an extension of the volcanic line evident in Minahasa. Athwart these meridional trends lies another continuing the ancient SW-NE. form lines of British North Borneo and marked by horst and graben landforms such as the deep collapsed block now containing the Sulu Sea which is edged with linear fracture remnants forming the Palawan and Sulu Islands. It may also be traced in the alignment of the Zamboanga Peninsula of Mindanao and in the islands of Negros and Panay.

The Philippines can be conveniently grouped as (1) Luzon, the large, well-populated island of the north; (2) the Visayan Islands, arranged roughly radially round the Visayan Sea, and including Samar, Negros, Panay, Leyte, Cebu, Bohol and Masbate; (3) Mindanao, the second largest island, well to the south; (4) Palawan and the Sulu Islands, stepping stones between the Philippines and Borneo. High relief is general throughout the islands which are surrounded by reefs and marine terraces of coral, accounting

for the difficulty of approach in modern times. Luzon and Mindanao are the only units of sufficient area to have distinctive regional differences within them.

Upon the islands limestone, shales and sandstones occur in small outcrops and cause local variations of soil.

To the north in Luzon the Cagayan Valley flows meridionally in a tectonic trough between the eastern high Sierra Madre Mountains and the Central Cordillera on the west, to form one of the key agricultural regions of the Philippines. Roughly paralleling it farther east beyond the Central Cordillera, the Middle Luzon or Manila Plain opens to the sea at both ends, at the Lingayen Gulf and Manila Bay, and forms a densely populated farming zone. The Central Cordillera extends south to the latitude of Manila, whence it is interrupted by a graben-like lake plain, the province of Laguna. South and east of Laguna, Luzon loses its meridional form lines to become a fretted, varied country of volcanoes, spreading from Taal Mountain behind Batangas to Mayon Mountain near Albay. On the east of Mindanao the Diuata Mountains repeat the meridional structural lines and are separated by the Agusan Valley from the Lanao-Bukidnon upland where groups of extinct volcanoes cause the Cotabato River to have a complicated course in part meridional, in part related to the SW-NE. structure of the Zamboanga Mountains, and provide soils whose qualities make the valley the largest potential agricultural area of the territory. Mindanao otherwise has a landscape of high rugged mountains and rolling uplands; Mt. Apo at 9,450 ft. is the highest Filipino mountain.

Throughout the Philippines drainage is by short, violent streams of immature development.

Climate

Insularity and latitude combine to make the climate of the Philippines distinctively even and mild in its temperatures which range between 75° F. and 85° F. everywhere and throughout the year. More variety from place to place and seasonally is evident in the rainfall régime yet even in this respect there are neither the extremes of total rainfall nor the seasonal contrasts to be found in comparable latitudes of Burma, Siam and Indochina. Streams of the southern and northern tropical air masses play over these islands in a rhythm differing from th rest of South-

east Asia as a result of the northeastern oceanic location. The northern air masses exercise by far the most continuous influence, flowing over the islands from October to April without modification as northerly and later easterly winds. May is the month of equatorial calms, particularly to the west. From July to August southern tropical air comes as winds from slightly east of south bringing very heavy rains everywhere, especially to the western islands.

RAINFALL IN THE PHILIPPINES (inches)

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Baguio	1.2	.7	1.9	4.9	15.8	15.7	42.3	45.5	28.3	17.0	3.4	2.2	178.6
Paracale ..	18.1	10.9	8.1	4.1	7.0	8.5	11.4	6.8	9.6	20.6	19.5	20.0	144.6
Manila	1.0	.5	.7	1.2	5.1	9.9	17.0	16.6	14.4	7.7	5.6	2.5	82.2
Tacloban	14.0	8.7	6.2	5.3	6.2	7.9	6.9	5.5	6.0	8.0	10.9	14.0	99.6
Zamboanga .. .	2.1	2.2	1.5	2.0	3.5	4.2	4.9	4.0	4.7	5.7	4.2	3.4	42.4
Cebu	4.2	2.9	2.0	1.7	4.5	6.4	7.2	5.7	6.9	7.7	6.4	5.0	60.6
Davao	4.8	4.4	5.2	5.8	9.3	9.1	6.5	6.5	6.7	7.9	5.3	6.1	77.6

These conditions interact with the variations of altitude and differences of aspect to produce four types of rainfall (Fig. 105):

1. An alternation of wet and dry seasons: a dry winter and spring followed by a wet summer and autumn bring to western parts of Luzon, Mindoro, Negros, Panay and Palawan a régime resembling that of Burma, though the cool season is more humid.
2. A wet season throughout the year with a distinct maximum in winter is characteristic of the Bicol district of South Luzon, eastern Samar, Leyte and eastern Mindanao.
3. An important variant of (2) has no pronounced heavy rainy season, yet considerable rains fall most of the year with a minimum but by no means a drought for about two months in spring. The Cagayan Valley, the plains round the Visayan Sea, and north-central Mindanao, significantly the important agricultural areas, experience this rainfall régime.
4. An insular uniformity of rains at all seasons, without pronounced wetter or drier seasons, occurs as a coastal régime along northeast Luzon, southwest Bicol and east Mindoro, western Leyte and most of central and western Mindanao.

Total rainfalls vary between 40 in. and 180 in. with highest falls on southwest aspects.

The Philippines form probably the world's most typhoon-infested area because just east of the islands is the zone where

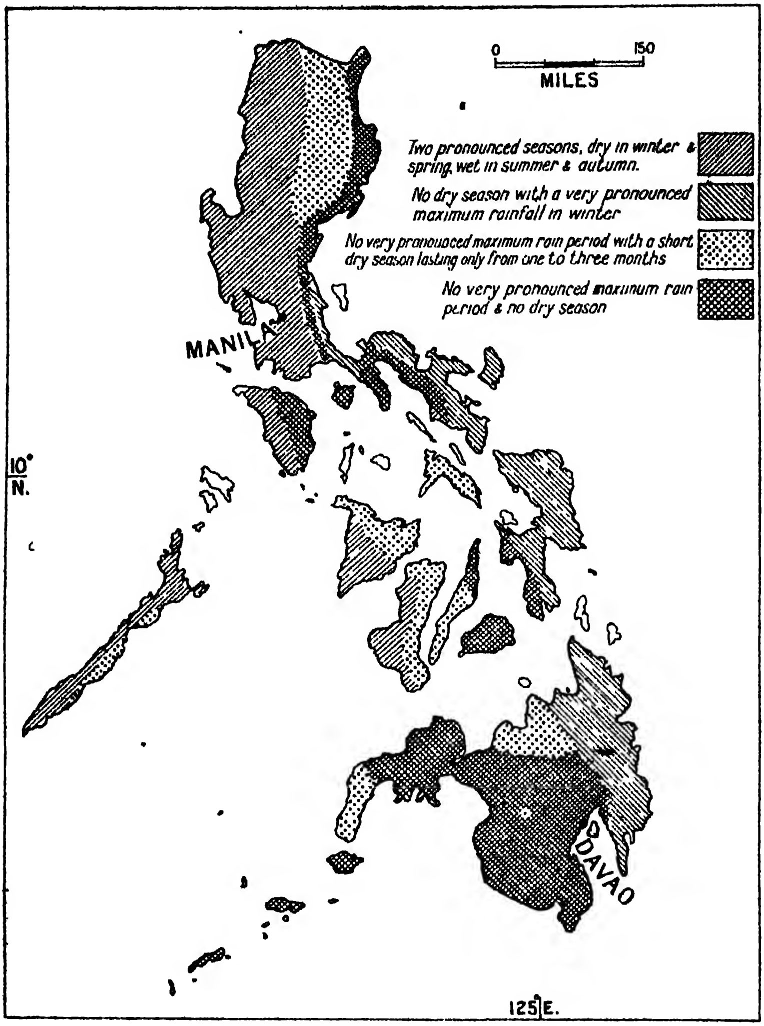

FIG. 105.—Régimes of Rainfall in the Philippines

begin the typhoons moving towards East Asia (Fig. 14), so that the Philippines feel the effects, if not always the full force, of most of those typhoons which finally cross Indochina, South China and Japan. In the period July-September the typhoon tracks invariably pass across Luzon. During November-December, which are also months of intense cyclonic activity, the tracks more frequently cross the Visayan Sea. At the onset of the typhoon

seasons, cyclones take a more south-to-north route across the Philippines. Very few typhoons ever cross Mindanao in which respect that island resembles the East Indies.

Soils

Recent and frequent tectonic changes have produced highly diversified soils upon which laterisation is the process operative almost everywhere in the Philippines, although mature laterites are infrequent. Large areas have immature transported or volcanic ash soils and many coastal plains have a fertile soil derived from weathering of extensive uplifted corals, as in Cebu. Regular soil renewal is here a prerequisite for the maintenance of fertility, and zones with regular local flooding by heavily silted streams (as in the Cagayan Valley) or with frequent addition of volcanic ash (as in Negros) support the intensest and longest established agriculture. A contributory factor in the general low quality of soil in the Philippines is the persistence of shifting cultivation (called *caiñgin*) coupled with a steadily increasing population, and few areas of the main islands are not suffering from overcutting or overburning.

Land Utilisation

About 15 per cent of the Filipino surface is cultivated, though cultivation is most unevenly distributed (Fig. 106). On Luzon, the Cagayan Valley and the west coastal fringe of the Ilocos and La Union are narrow cultivated belts. The Manila Plain and its extensions through the volcanic peninsula south of Laguna de Bay is now the largest and most continuous agricultural area in the Philippines. Coastal plains of the Visayan Islands, Panay, Negros and Cebu, are prosperous agricultural areas whose continued fertility relates to basic volcanic soils and weathered coral soils. Elsewhere agricultural units are small and isolated, often related to local alluvial fans and transported volcanic ash.

Forests and Mining

Large patches of Tropical Rain Forest persist in northeast Luzon, on Samar, southern Negros, Palawan and, largest forest of all, on Mindanao, where the continuous forest cover resembles that of North Borneo. Tropical Swamp Forests having little

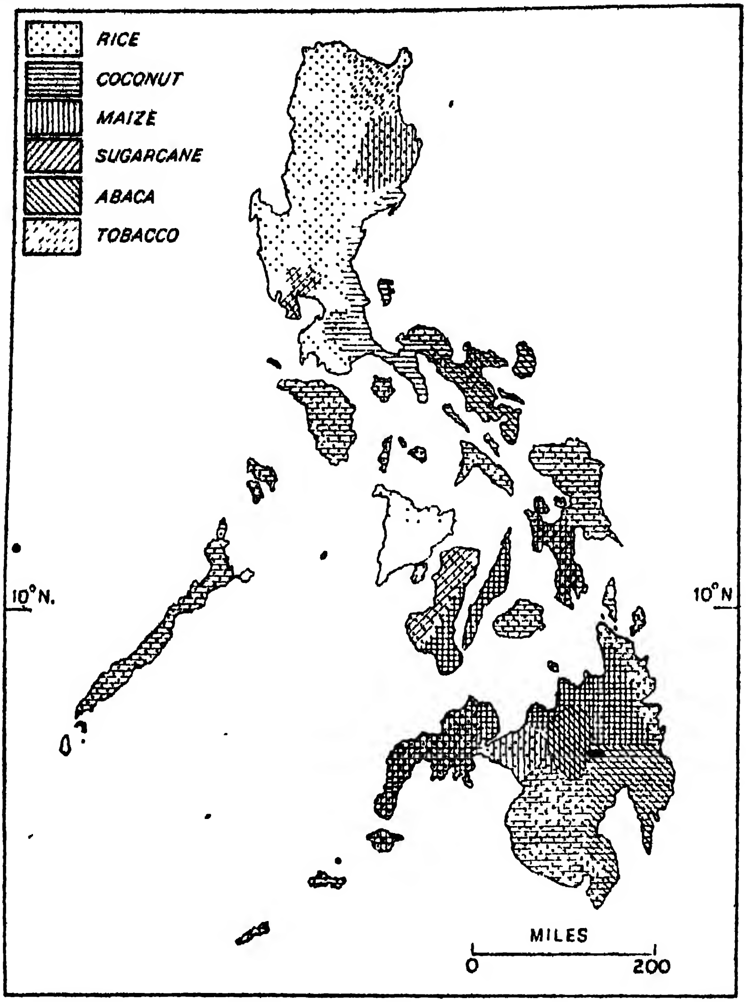

Fig. 106.—Agriculture in the Philippines

opportunity to develop in so youthful terrain, are only found round the lakes of the Agusan and Cotabato Valleys in Mindanao. Upon the Central Cordillera of Luzon relief has induced much pine forest. Large areas of Secondary Forest (called *cozon* in the Philippines) cover districts marginal to sedentary agriculture, where shifting cultivation is still widespread, i.e. on the flanks of the Central Cordillera, on Panay and Masbate and behind Cagayan and Cotabato on Mindanao.

Mining has had little effect on Filipino land utilisation and has played a subdued and infrequent note on the landscape. That the region has igneous formations in its structure implies some mineralisation, against which have operated the difficulties of exploitation and the relatively unattractive yield of any one deposit, except for the gold of Luzon. While Luzon gold and rumours about it drew external interest from as far afield as China and Spain at various times, large-scale exploitation of the gold is very recent, most mines dating from about 1913, since when mining rose to a peak of value and volume in 1940. There were about 200 goldmining companies in 1940, yielding 1.1 million ounces, valued at $76 million, chiefly in Mountain Province of Luzon and centring on the lodes of Baguio and Bontok. Production was down to 31,000 oz. in 1947. The absence of any considerable coal deposits, apart from the low-grades on Cebu and Albany, retarded development of other minerals, but the domestic output of coal has been strikingly increased as a result of postwar necessity; in 1946 about 440,000 tons of coal were extracted as against 41,000 tons in 1938. Iron ore, once mined at Camariñes Norte for export to Japan had not resumed output by early 1948. Chrome ore produced in Zambales already approaches its customary output of 190,000 stones annually, while the manganese of Sequijor Island south of Cebu and of Basuanga (between Palawan and Mindoro) is only slowly being extracted again. Copper, the traditional metal of the volcanic east, is coming from Mountain Province now at a rate faster than prewar; this was a trading article sought in Luzon by early Chinese merchants.

AGRICULTURE

Because it occupies a large area compared with other activities and employs over 70 per cent of all Filipino workers, agriculture has been the primary activity of the Philippines (Fig. 106). The types of crop are much the same as those of Southeast Asia, though differing in emphasis and equally unconcerned with animal farming. About 38 per cent of the cropped acreage is normally in paddy, one quarter of it on the dry system; 17 per cent of the farmland grows maize; tropical root crops (yams and tapioca) occupy 3 per cent of the cultivated area. These are all food crops grown for local consumption. In addition, 35 per cent of the cropped area is for commercial production and the emphasis in

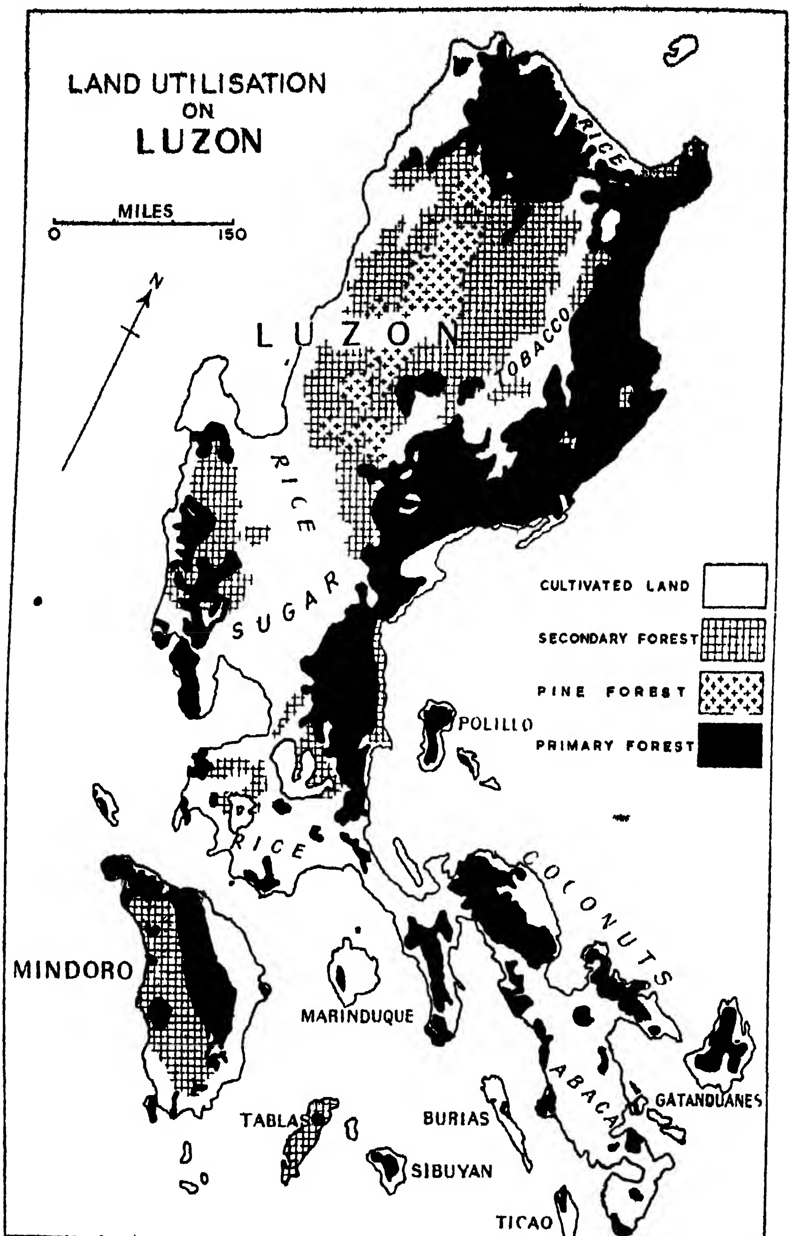

FIG. 107.—The Northern Philippines

the Philippines is on coconuts (on 25 per cent of the cropped area) with lesser acreages of hemp and sugar. The Philippines, by specialising in coconuts, clearly differs from the commercial cropping of most of Southeast Asia and relates more closely in agricultural pattern to the easternmost East Indies.

For social reasons, agriculture aiming at both food and trade has become more commercialised in the Philippines than elsewhere and maximum return, rather than sustained return, has been the farming objective, facilitated by the reliable, evenly distributed rains and the continuous growing season. Hence double cropping is very common Rice often follows rice on the same piece of ground and corn follows corn, and rotational schemes are not much practised except in non-irrigated farming among the hills. Thus in 1938, 9.8 million acres were cultivated and 11.8 million acres were cropped, which means that about 20 per cent of the fields were double-cropped.

Regional agricultural specialisation appears very distinctly, encouraged by spatial isolation and by great differences in soil. Rice will grow to some extent on every island, but the heavier soils, level landscape and alternating wet and dry seasons of Central Luzon cause that area to be specially suited to lowland rice. Coconuts, which need a climate without prolonged dry season, are extensively grown in South Luzon. Abaca (Manila hemp) has been found peculiarly successful under the even rains and high humidity of Davao where volcanic soils retain their fertility even with this exacting crop.

Luzon may be divided into five agricultural regions (Fig. 107):

(*a*) The Central Luzon rice area, where sugar cane is the chief subsidiary.

(*b*) The Cagayan Valley with large rice areas pressed well up the hillsides on the elaborate terraces of the Igorotes (whose skill pre-dates commercial farming), and supplemented by tobacco and maize.

(*c*) In the Ilocos-Mountain region of northwest Luzon rice, maize and potatoes are grown on the narrow coastal plain.

(*d*) In that part of South Luzon east and south of Laguna and including Tayabas, is a zone growing rice as subsidiary to coconuts on large plantations.

(*e*) In the extreme southern tip of Luzon, the volcanic region, rice fades out to give place to an agriculture specialising in

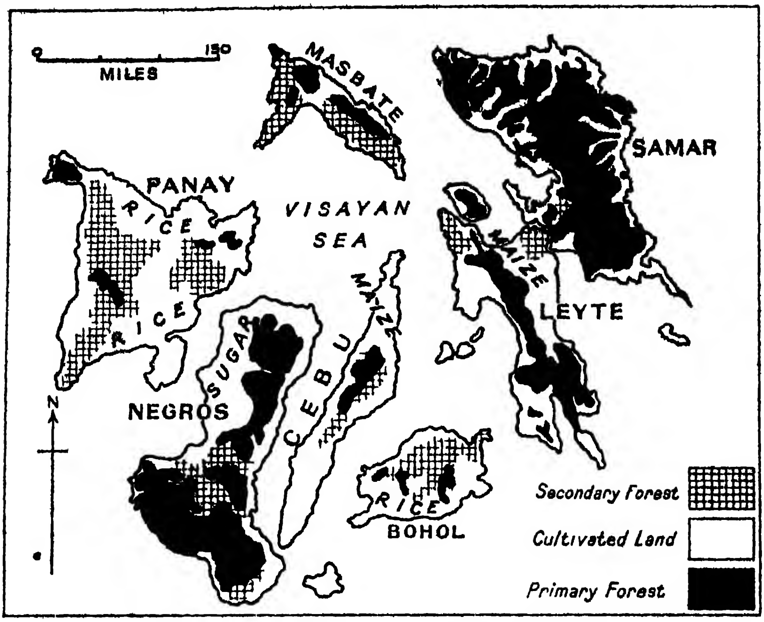

FIG. 108.—Land Use in the Visayan Islands

coconuts and abaca, the latter invariably associated with volcanic soils in the Philippines.

Among the *Visayan Islands* (Fig. 108), a zone of vigorous agricultural activity, Panay specialises in rice, and western Negros in sugar cane. Cebu is a maize island with subsidiary rice. The other Visayan Islands have a poorer agriculture based on rice, coconuts and a little subsidiary hemp and maize.

Mindanao, an undeveloped island (Fig. 109), is fringed with subsistence farms cultivating a little rice, maize and coconut, except in Davao where half the cultivated land carries hemp and a large acreage is in coconuts. In recent attempts to colonise this island, the uplands were leased as pastures but the success of animal husbandry there has yet to be demonstrated.

Farming methods resemble those of all Southeast Asia. The hoe, the mattock and small sickles (*karit*) are used in rice farms, and the wooden ploughs are of the older soil-opening rather than the soil-turning type. While much discussion of mechanical methods went on during the American colonial period, in total the modern tractor and harvester have had no significant place in

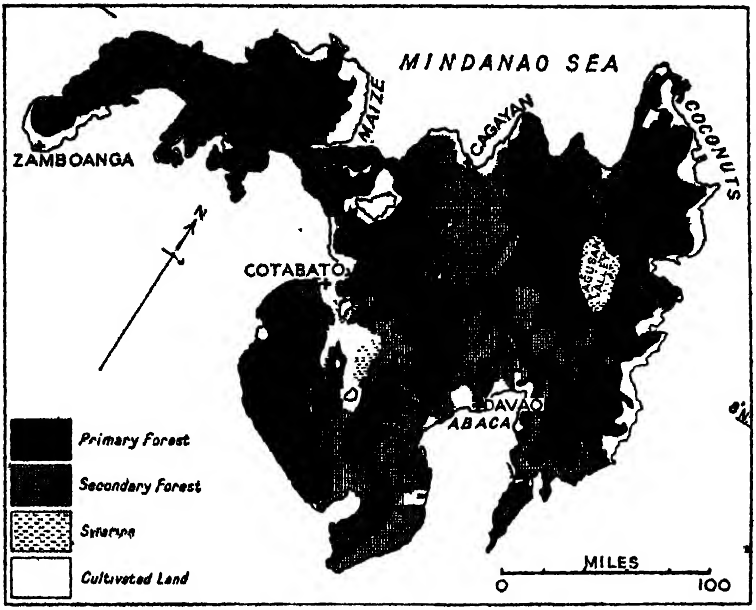

FIG. 109.—Land Use in Mindanao

the Filipino agricultural system, which is essentially small-scale family farming. Over half the farms (as distinct from the properties) contain less than 5 acres each and about a quarter have only 2½ acres each. Farms are, however, much bigger in the commercial crop and pioneer areas of Mindoro, Mindanao, Negros and Masbate.

Irrigation is chiefly for rice, aiming to control and distribute water rather than to counter drought, so that most systems have no storage or reservoir arrangements. Only upon the irrigated land is double cropping possible. Sugar has been farmed on irrigated land to a minor extent—differing in this respect from the technique in Java. The Igorote water systems of Mountain Province are at least twelve centuries old and repeat in the Philippines that skilled and intensive farming evident on the Javanese hills. While 1¼ million acres of the Philippines were reported as irrigated in 1940, it was mostly mere bunding to retain direct rainfall. Over three-quarters of the irrigated land is in the Manila Plain.

Over the period 1946–50, agricultural yields in the Philippines

were consistently low, lower than the Southeast Asia average. Only 630 lbs. of rice were obtained from each acre, less than that of any other Southeast Asia territory where yields in any case are low. In Luzon the yields are better than the Filipino average, usually by nearly 50 per cent.

Rice.—Self-contained subsistence farming is less prominent in the Philippines, for historic reasons, than in other Southeast Asia territories, but local foods, of which the most important are rice, maize and yams, occupy nearly 60 per cent of the cultivated area and meet the major food needs of the Filipino population as a whole. Prewar rice production was about 1.4 million tons annually as against 1.7 million for 1950. The islands are complementary in their food production and mutually self-supporting —normally the group neither imports nor exports rice internationally on any appreciable scale.

Rice stands upon 40 per cent of the cultivated land, to provide the most important single item of Filipino diet as well as a cash crop. While grown by small farmers for domestic consumption, large commercial estates (*haciendas*) of rice exist in Central Luzon and Panay, districts containing 30 per cent and 12 per cent respectively of all Filipino paddyland. Mindanao carries 10 per cent of Filipino paddy, reflecting the size of Mindanao rather than a special interest in rice production. Two-thirds of the total crop comes from Luzon alone, the chief rice surplus area, whence rice is shipped to the other islands, particularly to the Visayan islands which, though intensively farmed themselves, are also densely populated and form a zone of net rice deficiency. Nearly a quarter of the total rice production was of upland varieties largely from shifting cultivators who are prominent in the hilly, less developed areas of Batangas, Cavite, Mindoro, Palawan and Zamboanga. Altogether a thousand distinct varieties of rice are recognised, indicating the subtle variations in local conditions. Transplanting is the usual method for lowland rice which has two seasons, as against one for upland rice, sown on the broadcast system.

The first lowland wet paddy is transplanted as early as May in Mindanao, but is deferred until July to the north in the Cagayan Valley. This will be harvested from September in the south to January or February in the north. Second cropping is not customary far south: on the Visayan Islands second transplanting

starts about November for harvesting in April and in the Cagayan Valley starts in February for harvesting at the end of June. This latitudinal variation in the timing of heavy work periods has major significance in encouraging inter-island migration of harvesting and planting labourers.

Dry paddy activities are a month or two earlier than those of the first wet paddy cropping.

In keeping with the practice of other Southeast Asia territories, rice harvesting makes heavy demands on labour because the cutting is by hand with a small sickle or a knife (the Filipino *yatab* is like the Malay *tuai*) and even farmers with a few acres are obliged to use outside labour, customarily on the basis of giving the harvesters a portion of the crop. Communal farming help is less common in the Philippines than elsewhere, probably the result of long association with Spanish land usages. Only in the intensive paddy-growing districts such as Central Luzon are modern rice mills to be found and milling is generally done by hand, after foot-threshing and wind-winnowing the rice.

From Central Luzon milled rice went to Manila by rail, road and coastal vessels, the largest surpluses originating in Nueva Ecija, Tarlac, and Pargasinan. Thence it was traded exclusively by sea to Cebu, Davao, Albay and Negros, at two peak seasons of rice movement, January-February and August. This internal rice trade was largely done by Chinese dealers, paralleling the condition in most parts of Southeast Asia, with the result that Filipino nationalism was often directed to eliminating these "foreign" intermediaries even though they were frequently long-standing residents in the Philippines.

Maize.—Maize became one of the staples of Filipino diet as an effect of early and prolonged colonial association with Central America where maize was indigenous. It is grown a little on the upland belt with distinct wet and dry seasons, but is more general in areas without a dry season and it is very popular with shifting cultivators. For food, the maize is sun-dried, ground and eaten in various dishes resembling those of rice. It occupies a little less than half the acreage devoted to rice, the greatest single producing area being Cebu where half the cultivated land is under maize, producing a quarter of the Filipino total. Negros, Leyte and Mindanao between them account for nearly half the total maize acreage and the people of these four islands have become principally

maize-eaters. Maize was also prominent in Bohol, Masbate, Isabela and Cagayan. Only a low yield was obtained, to produce 475,000 tons altogether (1947). In Cebu signs of soil exhaustion were becoming apparent in the maize yield which was there much lower than the Filipino average. Several maize crops can be raised each year and three seasons of planting-harvesting can be recognised though the first produces 60 per cent of the total, and the third crops are quite small. The chief seasons are (*a*) late winter or spring sowing (January to May), and (*b*) autumn sowing (October). Harvesting is in each case about three months after planting.

Other Foods.—While they occupy only a small acreage in any holding, yams, sweet potatoes and tapioca are prominent in local diet and very widely grown. During the war years these roots, which are easy to grow, attracted cultivators and increased their total acreage in 1947 by .35 million compared with 1938, to that extent offsetting rice shortages. Large quantities of legumes and savoury or peppery vegetables are cultivated to form a rounded diet which for most Filipinos is vegetarian, here by obligation rather than by religious conviction. The chief source of protein is inshore fishing which produces exclusively for local trade. Animal farming is negligible though buffaloes and oxen are the usual rural draught animals, the former being customary in the rice and sugar areas. Loss of half these animals during the war was the most serious obstacle to rural rehabilitation. No island specialised in animal breeding which is a widely distributed small-scale interest producing no animal exports.

Commercial Crops.—Of crops grown fundamentally for commerce, the most important have been sugar cane, coconuts, hemp and tobacco, together with small areas of crops which have been tried in nearby territories. Rubber has significantly not been taken up, although Mindanao has suitable climatic conditions; apart from about 800 tons produced annually from Zamboanga, interest in rubber was negligible.

United States Influence.—The reasons for the subdued development of Filipino commercial crops are:

1. The early Spanish colonial system did not encourage pioneer agricultural activities.
2. The change of colonial power in the Philippines towards the end of last century, followed by a Filipino-American War

meant a state of insecurity and uncertainty at the very time when most other Southeast Asia territories were going ahead with commercial agriculture. By the time pacification had taken place, other tropical areas were too competitive to encourage new rivals in rubber or rice production.

3. Association with the United States tariff systems and the virtual autarchy of North America operated against the production of Filipino sugar, which had to compete with Cuban and Louisiana cane, of Filipino fruits, which rivalled Californian and Hawaiian products, and of Filipino tobacco, rivalling that of Georgia.
4. There was a sufficient field for investment and pioneering in the United States to dissuade from similar initiative so far away in the Philippines.
5. The working of Filipino gold mines conveniently paid for United States manufactured imports without stimulating Filipino agriculture to long-term improvement.
6. Isolated by distances and by politics from the rest of Southeast Asia, the Philippines were little influenced by experiments, incentives, and developments taking place there.

Sugar.—Although coconuts occupy the greatest cash crop acreage, sugar cane had first place in value. It was estimated for 1940 that 2 million Filipinos depended on sugar for their livelihood, $500 million were invested in it, and over the quinquennium 1935–39 sugar formed 45 per cent of export values. Among the world's major sugar producers, the Philippines ranked after India, Cuba, Java and Formosa. Sugar growing practically disappeared in 1942 with violent repercussions in Filipino country life; by 1947 only 9 per cent of the sugar acreage had been replanted and the production of sugar fell from its prewar annual average of 900,000 tons to 71,000 tons, which is less than half the domestic consumption.

Commercial sugar-growing centred on Luzon and Negros which combined about equally to produce 85 per cent of the total output. The Luzon sugar zones are Tarlac, Pampanga, Batangas, Laguna, Pargasinan and Bataan. Negros sugar plantations concentrated to the west of the island. In Luzon, sugar grows in conjunction with rice as a smallholding crop, half the farms averaging less than four acres each of sugar. The estate or *hacienda* system is more typical of Negros where there are over 400 estates cultivating

between 250 and 650 acres each. Upon each of these as many as 250 men will be needed during the milling season, tapering to about a quarter of this number for the rest of the year. Hence for the brief harvest period thousands of labourers must be brought from Panay and Bantayan. Because the cane grows best on a sandy loam which is not flooded even during the rainy season, upland locations are favoured. Haciendas use mechanical equipment for ploughing, smallholders the buffalo and wooden plough. Planting is begun in October to the south, continuing until January farther north. On Negros second cropping of new canes rising from the old root stock (ratooning) is common, as in the West Indies. Harvesting starts in November and may go on through April, labourers using the *bolo*, a form of chopping knife common throughout these wooded zones (*vide* the Malayan *parang*). Haulage to the mills, known as "centrals," is by narrow-gauge railway in the commercial areas, or by cart to small mills producing coarse sugar for local use.

The system of milling is the one common even in Europe in sugar beet areas; the mill is a private concern entering into agreement with growers who undertake to plant a certain acreage regularly over a pre-arranged period which may be as much as three years. In return, the mill extracts the sugar on a percentage basis, retaining 40–50 per cent for their service. The balance of sugar is sold by the grower directly, through a cooperative, or through the mill as broker. Mills do not purchase sugar outright nor engage in planting. Of the centrals in 1941, 16 were on Luzon, 18 on Negros and 6 on Panay.

The average production over 1930–39 was nearly 1 million tons of refined sugar. This was double the amount produced in 1921 but represented a diminution of peak production (in 1933 it was 1.7 million tons) under a quota system arranged with United States producers. In one centre the fibre from the cane was used for paper-making and to brew large quantities of potable alcohol produced everywhere as a local liquor called *basi*. Production of sugar was distributed thus: Luzon, 33 per cent, Negros 59 per cent, Panay 5 per cent and, though the acreage of 1921 was about the same as in 1939, yield per acre had in fact doubled.

Coconuts.—In acreage planted and number of people engaged, coconuts have been an outstanding feature of Filipino cash farming. Over 2½ million acres under coconuts gave employment

to 4 million Filipino people, to produce, for the 1935–39 period 29 per cent of export values. No other single state exported so much coconut and the Philippines supplied one-third of all vegetable oil exported from Southeast Asia. Coconut cultivation proved remarkably elastic over the war period largely because the trees are perennial and production can be increased or decreased within wide limits solely by varying the intensity of collecting the nuts. Most smallholders have coconuts growing on their land; whether they harvest or not depends on the inducement. Thus the yield in 1947 was nearly double that of the prewar average, enabling Filipinos to offset the collapse of their sugar industry.

Some 30 per cent of acreage under coconuts is in southern Luzon, on the wetter east side out of the track of the more damaging type of typhoon. On Mindanao was 22 per cent of the coconut acreage. Large plantations do exist, yet most of the crop comes from scattered smallholdings. The tree is a continuous producer after six years and smallholders harvest the dropped nuts rather than organise gathering from the tree. Ninety per cent of the nuts go to make copra, one-third by sun-drying, the balance smoke-dried. Over 1934–39, nearly .6 million tons of copra were exported annually, and the estimate for 1950 was .8 million tons. Copra is sacked among the islands and shipped in small boats to Manila, centre of the oil extraction and export trade, and to Cebu which reshipped overseas without processing.

Abaca.—This perennial plant, yielding a fine hemp-like fibre (Manila hemp), resembles a related species, the banana, and reaches heights of 10–20 ft. The fibre comes from the leaf sheath on stalks or shoots, of which 12-20 may grow from a single root. It is native to the Philippines, whence a large portion of the world supply still comes and averages 14 per cent of Philippine exports.

Abaca grows on rolling hills of well-drained fertile soil where there is an even heavy rainfall; a dry season is unfavourable. It grows commercially in South Luzon and Davao, the former carrying 43 per cent of total acreage, on a mixed farming basis, the latter having been a Japanese-managed speciality grown alone, and not in association with other crops. From a total area of three-quarters of a million acres, about 165,000 tons of fibre were produced, of which nearly half was from Davao; in 1947 production was half the normal. The fibres are extracted by a serrated or

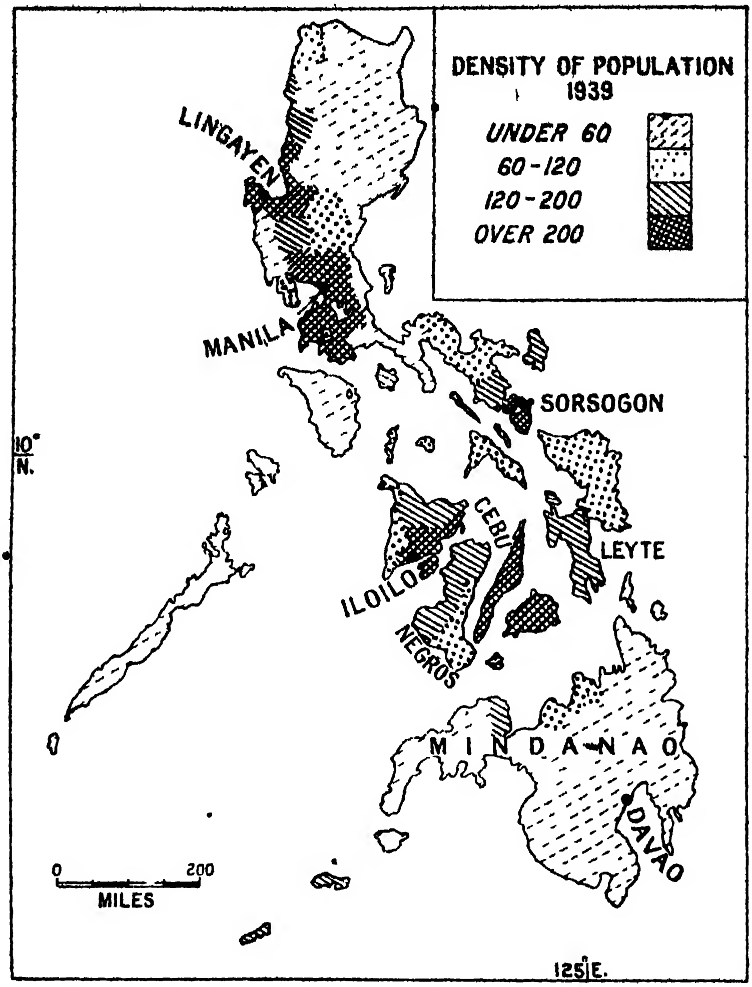

FIG. 110.—Density of Population per square mile in the Philippines

smooth knife drawn up and down the sheath. One plant may go on producing for 25 years.

Tobacco.—First introduced from Mexico by Spanish missionaries, tobacco found the Philippine climate suitable and became commercially important after Filipinos learnt the smoking habit. During most of the 19th century tobacco was strictly a government monopoly and thereby restricted until the United States became accessible this century as market for Filipino cigars.

Tobacco averaged 5 per cent of Filipino exports, for marketing in Spain, France, China and Japan from the tobacco areas of Cagayan, Cebu, Panay and Negros. Tobacco plants brought in from near Medan (Sumatra) have become favoured commercially in the Philippines. Production in 1947 was a third of prewar and was continuing to decrease.

The minor cash crops are: agave, grown for its fibre which resembles abaca; cotton, which has never been a leading crop despite Spanish hopes; kapok; coffee, which has lost the importance it had late last century, and derris, for insecticides.

The Population Patterns

An uneven distribution of people has developed in the Philippines (Fig. 110). Of 19.5 million Filipinos (1950 estimate), 24 per cent live in the intensively farmed zones from the Lingayen Gulf southward through Manila and Laguna to Batangas. About 35 per cent of Filipinos live in the narrow congested plains encircling the Visayan Islands, forming a separate nucleation of people on the volcanic and weathered coral soils. Cebu and Pargasinan are by far the most densely populated areas, each exceeding 400 people per square mile. On the other hand, Palawan, Mindoro and Mindanao each have less than 25 per square mile, though north Mindanao has fairly well peopled pockets along the coast.

The picture is one of congested pockets and plains separated by nearly empty forested interiors where wander aboriginal tribes or an occasional pioneer practises shifting cultivation. The average nutritional density for the Philippines is over 1,000 per square mile of cultivated land, a very different picture from the overall 135 per square mile. Not counting urban groups, rural areas of Ilocos and Cebu have over 1,750 persons per cultivated square mile, so that the nutritional density is as high as anywhere in Southeast Asia.

Only to a very small extent did this local congestion produce migration to the emptier islands. Official encouragement to this end produced as little permanent result as in the East Indies. There have been two distinct types of migration:

1. An inter-island seasonal migration, at the end of which migrants returned to their home districts. The latitudinal extent of the Philippines and the consequent varying times of harvesting made possible this migration for wages which took the following lines:

(*a*) From Ilocos on the west Luzon coast, to the tobacco farms of the Cagayan Valley.
(*b*) From Ilocos and La Union to the paddylands of Central Luzon and the sugar haciendas of Pampanga and Laguna.
(*c*) From Iloilo, Antique and Cebu to Western Negros sugar haciendas.
(*d*) From Cebu and Bohol to the coconut and abaca plantations of Mindanao.
(*e*) From Capiz, Batangas and Pampangas to the sugar plantations of Mindoro.

In this migration the labourers went to the same sort of work they did in their home districts. Some three-quarters of a million workers were usually involved in these movements, which varied in volume and direction with the yearly success and market value of each crop.

2. Long distance migration: while Filipinos were still United States citizens they moved in considerable numbers into the western United States for a long period, hoping to return with enough money to settle comfortably in their home districts. Much of the oriental labour force in the western United States was Filipino. Over the quinquennium 1934–38, the net movement was a return to the Philippines because conditions in the United States were decreasingly favourable; for that period, emigration from the Philippines averaged 6,000 and immigration 23,600 per annum. This was characteristically a male migration, the families remaining in the islands. For a time organised migration of sugar workers under contract to the Hawaiian plantations also went on until recruiting ceased in 1932, after which it was disorganised and was merely part of the drift of Filipino emigrants eastwards across the Pacific. In all cases there was some permanent settlement by Filipinos overseas, particularly in Hawaii, that half-way house between East Asia and North America, whose conditions resembled those of the Philippines.

While there had been a steady gravitation towards the towns for many years, the Filipino was distinctly agricultural and rural. There were only six towns of more than 50,000 people in 1939.

Composition of the Population.—Like its neighbours, the Philippines has a complex people derived from stock of contrasting types (Fig. 118). Originally the Philippines was populated by

Malayan types and for the period 1292–1478 it was under the influence of the Majapahits from Java whose impact was greatest and most prolonged to the south. The Malay stock penetrated the islands from the sea, driving inland those aboriginal tribes of Negrito type still to be found in northeast Luzon, in the Sierra Madre, inner Panay and Negros, and in the Surigao Peninsula of Mindanao. The Philippines escaped direct colonisation by Indians, and Islam spread along that old trade route (Fig. 114) from Makassar and the Moluccas northwards, converting the Malay stock of southwest Mindanao and southern Palawan. The bulk of these southern peoples remained animists of the Borneo type, as they still are in inner Mindanao, Palawan, Mindoro and the Central Cordillera.

From 1565, Spanish influence was strong and emphatic, operating colonial methods and policies already worked out in Central America. The Spanish focus was Manila and the cultural influences of Christianisation and hispanisation spread from there radially southwards to have much effect in the Visayan Islands, but leaving Mindanao an Islamic area which Spaniards never completely controlled. They discreetly left the "Moros" alone. The Spanish cultural influence continued so long that 80 per cent of Filipinos are Christianised as against 4 per cent Muslim. This reflects the deep hispanisation, both by intermarriage and by education, of the Philippines today, though the Spanish colonial aristocratic group is rapidly diminishing. The place and personal names are strongly Malay to the south, and increasingly Spanish to the north.

Spanish infiltration into the stock was not the only process of mestization which has gone on in the Philippines. Chinese were well established in the northern islands when the Spaniards first came and they staged at least two risings against the Spaniards in the 17th century. Chinese have continued to trade and to act as middlemen during the two successive colonisation periods undergone by Filipinos, who were themselves not attracted by trading activities. For that reason in Luzon and the urban centres there has been a considerable cross-marrying of Chinese with Filipinos, evident in the more active personalities of Filipino public life. The cross currents of Malay, Spanish and Chinese stock have become confused and the distribution blurred so that the Philippines may be described as a mestizo territory, yet

another point of resemblance to conditions of Central America rather than of Southeast Asia. The Philippines is unique in Asia for the mestization which has been achieved.

Equally complex is the language situation. Sixty-five languages and dialects have been officially recognised. The Visayan (sometimes spelt Bisayan owing to the character of the Spanish initial V's) language is that of the densely populated central islands and is spoken by the biggest single group of Filipinos (44 per cent) who distinguish between Cebu and Panay variants of it; it extends also to the agricultural fringe of Mindanao which has been settled by Cebu migrants. Tagalog, the speech of Manila and the more thickly populated provinces round it, is returned as the speech of 25 per cent of Filipinos and is slightly exceeded in importance by English, returned as the speech of 27 per cent Filipinos. Iloco is spoken by 15 per cent and Bicol by 8 per cent of the people, after which comes Spanish, now spoken by only 2.5 per cent of Filipinos and likely to disappear. Chinese is used by less than 1 per cent of the population, that is, by the more recent immigrants living in Manila, but it is in use in most trading centres of the islands.

English as a language dates from this century, a result of United States colonisation which ended in 1946. Following the Spanish example, Americans stressed an education in their own language, which has been most effective in the urban centres, leaving the countryside to use local dialects. Filipino indigenous languages are non-tonal and romanised, except in the south where people use a flowing script of Arabic style. Ordinary Malay or Javanese is not spoken, the southern dialects being more related to North Borneo speech than to modern Malayan or Javanese forms.

Overseas Influence

Off the beaten track to and from Southeast Asia, the Philippines differs from all neighbouring territories in its long trans-Pacific association. Adjoining territories have been involved to various extents in the interchanges and interactions between India, China and Europe; the Philippines was for the last three centuries connected with Central America whence the Spanish colonists first came and to which they looked for economic, political, religious and social example in dealing with the Philippines. The last and

final stage has been trans-Pacific association with the United States, as a poor relation rather than as an objective of major economic or social developments.

A heritage of Spanish colonial influence is the unusually high proportion of landless farmers in the Philippines, unequalled anywhere else in Southeast Asia. At the last detailed census (1948) less than half the farmers owned the land they worked, about 16 per cent owned some of the land they worked and 35 per cent were tenants on a sharing basis. This was at the end of strenuous United States efforts to undo the social evils and economic paralysis left by the Spanish aristocrats in rural areas.

Spanish Influence.—It is interesting to trace this Spanish influence on land holdings because they left behind problems resembling those in their American colonies and in Spain. They found in these islands the system of communal land holdings and communal help common to equatorial Asia and they observed that there was a head of this local communal activity with rights to direct it, but they did not realise or acknowledge that he was a communal centre-piece rather than the proprietor of village farmlands. Spaniards treated him, however, as the local landlord and gave him additional rights in return for his aid in taxation. They grafted into this their own colonial system of land grants to individuals who had feudal rights over property and persons living on the land. At that early time the population was much less than now (less than 90,000 people lived on Panay in 1586 and they had increased to over a million by 1928), and huge grants of land (*encomiendas*) were given to encourage settlers from Spain as well as to reward people who had been useful. This was easily possible in newly developed territories.

The local leader thus became a *cacique*, as the Spaniards call one of these feudal landlords, or a foreigner came to act as one. The land became the property of one person and everyone on it lost his land rights, thereby forming a group of landless labourers. It was a system evolved in Spain when communal cattle-grazing lands became enclosed for cultivation. By this system the Spaniards created for the first time in the Philippines a landless population in a territory which had been one of subsistence farmers. Latifundia (large estates of absentee landlords) followed as a matter of course. The rural people were reduced to tenants or workers for wages, whereas they had been traditionally partners in their

community, with equal rights and obligations in the food production. The degree of thoroughness with which this foreign system became established depended on the firmness of the Spanish hold, hence even now the highest proportion of landless farmers is round Manila and in Panay. Least tenancies appear where the Spanish system never became well established—in Mindanao, Palawan and North Luzon. Operating to increase the concentration of property was the gradual acquisition of huge properties by the religious houses and the tendency, noted elsewhere, of people newly introduced to money systems to mortgage their property.

The *caciques* continued through the United States colonial period and reaped most of the advantages therefrom. Land was a major social problem in the Philippines, a circumstance not fully paralleled in adjoining territories. There was a highly educated class of landed proprietors, who were prominent in all agitations for political power, and an illiterate, defenceless landless group of rural workers, tending to migrate to places where wages were high, but often unable to move from their districts because they have become deeply indebted to the landlord.

The usual form of tenancy on rice land is the share tenancy (*kasama*) by which a proportion of the crop is retained by the tenant. The proportion varies according to whether he merely works the land and has seeds and animals provided for him (which gives him half the crop after half costs for these items has been deducted) or whether the tenant supplies his own animals, seed, harvesting labour, etc. (which obtains for him two-thirds of the crop). While at first glance reasonable, these terms in kind operate against the tenant, who in poor years may receive for his labour less rice than his family needs to feed it, so that he must borrow to get through the year and meet his taxes, whereas, whatever the state of the crop, the landlord gets a clear return which is probably worth more in cash to him in a scarcity year than in a normal year. It is a case of partial cooperation, seemingly fair, but inevitably getting tenants progressively into debt because they bear all the risks of cultivation. A modern evil has been subleasing; landlords lease *haciendas* on a cash rent basis to a few tenants, who in turn sublease on sharing terms to many smaller tenants whose position and risk becomes increasingly desperate as pressure of population on the paddylands increases. Landed corporations were tending to

maintain this system, which gave them returns at minimum bother to themselves. Expropriation of large estates became part of the Filipino constitution after 1936 and the laws prohibiting new large estates operated to divert United States plantation interest away from the Philippines to other parts of Southeast Asia. Tenant indebtedness in the Philippines has been as bad as in Burma and Siam. These land questions have constantly moulded the political life among Filipinos.

The Philippines thus clearly differs from Southeast Asia in being far from the pioneering stage and also entangled with Spanish land systems. The coastal Filipinos have a traditional culture based on the wood and woven palm ecology of Southeast Asia which they have developed with artistry and enthusiasm. Their music, however, is of the Spanish guitar type rather than the pipe and finger-drum type of Indian and forest origins.

In Mindanao there are still empty spaces, but it is doubtful whether these can absorb the excess of specialised farmers from Luzon and the Visayan Islands, without tremendous preliminary developments of roads and clearing schemes. It is as difficult in the Philippines as in Java to cause relief of rural populations by migration to virgin territories. An adequate incentive has not yet been found and it is clearly not enough to have a population pressure in the home districts.

So far there has been little evidence that modern industrialisation is practicable for the Philippines. Before the war a few cement plants, coconut oil mills, sweet and shirt factories had grown up, but there was neither local coal nor hydro-electric power. Only in cottage industry, particularly for hats and clogs, was there any considerable development, and this was rivalled by similar products imported very cheaply from China and Japan. Cigar making was shifting from the home to the factory. Embroidery too was changing from a cottage industry to small village factories. Some home weaving persisted on the basis of local fibres and on a little cotton grown for domestic use in Luzon.

The whole geography and ecology of the Philippines is a special extension of conditions similar to those of Southeast Asia, particularly of the eastern East Indies, but modified by several centuries of control and influence from America rather than from India, Europe and China. As in the case of Burma, the current problem of the Philippines is physical rehabilitation after two

military campaigns, which have each caused extensive damage and disruption. The campaigns of the Philippines were firstly in Luzon and secondly in the Visayan Islands fanning out from Leyte. Manila suffered physically from the war more than most parts of Southeast Asia.

PART III

THE HUMAN GEOGRAPHY OF SOUTHEAST ASIA

Chapter Twenty-two

SOUTHEAST ASIA AGRICULTURE

SOUTHEAST Asia has several agricultural types which are, however, less related to major climatic or environmental differences between one place and another and more to differing rates of agricultural development. To these rates of development the greatest impulses have derived very largely from conditions outside the region and most of the crops concerned have been introduced from outside. The system of shifting cultivation, often described as indigenous to Southeast Asia, is associated with all tribes and groups entering Southeast Asia overland from continental Asia, and the key crops of today, rice, sugar, tea, coffee cotton, rubber and maize have all been brought from overseas and cultivated largely with the object of sales overseas. Prior to the introduction of these plants, agriculture centred on root crops, on sweet potatoes or yams, which are still staples for the more isolated and hence more primitive groups.

SHIFTING CULTIVATION

Of the agricultural types particular interest attaches to shifting cultivation because it represents a special stage in the evolution from hunting and food gathering to sedentary farming. Within this style considerable variations exist, from the clearing used for cultivating yams and bananas, probably the earliest form of land utilisation by peoples wandering through the jungles, to shifting cultivation of coffee and pepper by farmers intending to sell these crops, which are so exacting in their soil requirements. Some shifting cultivators are true wanderers : the whole group, family or tribe, moves on to a new location when it abandons one clearing for the next. Others are sedentary farmers, staying in one village all their lives, but varying the piece of ground they cultivate from time to time, abandoning the old piece to secondary forest growths, which can be thought of as a form of fallow. This last type has a long tradition in Java, the Philippines and Indochina, and has blended with the custom by which a tract of land belongs

to a group, the individuals of which choose or are given, every now and again, different portions to cultivate for themselves.

Within Southeast Asia the shifting cultivation system has no relation to the needs of domesticated animals. There is no evidence here that the simpler tribes have been primarily cattle grazers, except in so far as all Mongoloid types coming south overland

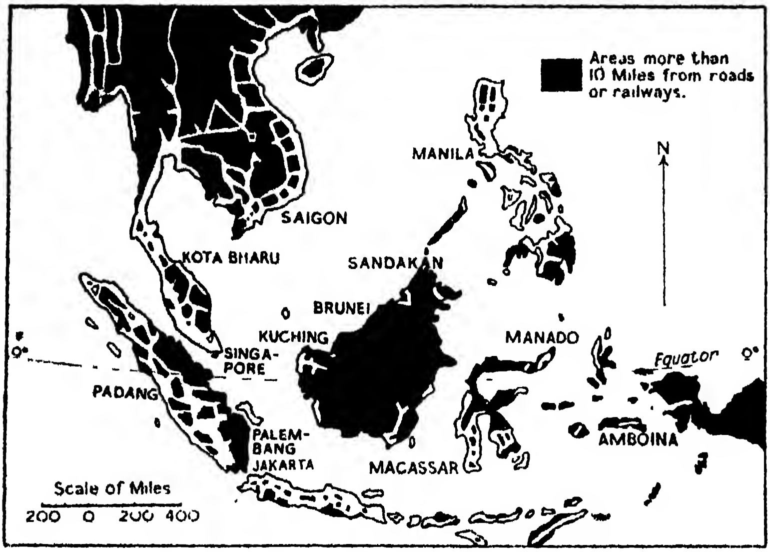

FIG. 111.—The Accessibility of Southeast Asia by Land

from the grazing grounds of Tibet and farther north may, at remote times outside this territory, have been associated with animals. Inside Southeast Asia, cattle do not fit well into the ecology of climate, vegetation and pests, and the disinterest in animals has become part of the religious tradition; Buddhists and Hindus do not eat beef, Muslims will not eat pork and even the primitive animists have similar inhibitions. Wherever today there has grown up a cattle system, it relates to the ploughing needs and is concerned with buffaloes or small oxen and does not derive from an earlier tradition of cattle farming or nomadism.

Shifting cultivation is a system well adapted to large empty areas where soils are poor and the rate of soil erosion high. As soon as population increases, shifting cultivation, which needs each cutover area to stand unused for 7 to 10 years before being

recultivated, rapidly overtaxes the capacity of the forest vegetation to reassert itself. Hence much of Southeast Asia has been progressively overburnt by the increasing forest population and the natural cover has selectively changed towards the savannah vegetation type, a progress speedier in the drier zones where the regrowth rate is slower. Overburning caused by overpopulation in turn induces rapid soil erosion, affecting the load and silting of river systems, possibly disturbing settled agriculturists far down the valley and remote from the overburnt area. For these reasons shifting cultivation has generally become illegal, yet it still persists in areas not easily accessible or amenable to control and probably even today as much as 5 million acres of temporary clearing each year is being cultivated over Southeast Asia, and between 40 and 50 million acres of clearings in the forests is being cultivated or is recovering from recent temporary cultivation—an area not far short of the total area of Siam. From the shifting agricultural system, very little that is of trading or commercial significance derives; the proportion in coffee and pepper is negligible. As a whole, shifting cultivation is for subsistence only, yet it is an integral part of the regional farming tradition.

Subsistence Farming

Farming of the ordinary sedentary type has in this region evolved from shifting cultivation as pressure of population on the land increased. Fixed cultivation can only be sustained where local conditions prevent soil exhaustion and soil erosion, or natural conditions counteract these inevitable effects of cultivation. Thus farming gravitates to the localities dry for a part of the year, where leaching is a periodical rather than a permanent process, to localities where erosion and leaching are negatived by altitudes nearly at base level, to zones where the soil is the accumulation of fertile elements from other areas, or to zones of young soils rich in nutrient chemicals. The dry zones are away from the Equator and towards the "monsoonal fringes" of the tropics; flat flood plains beside mature streams are subject to little erosion and leaching; deltaic and basic volcanic soils remain fertile for long periods. These facts underlie the pattern of sedentary farming in Southeast Asia which occupies a total area of almost 97 million acres.

The greater part of this farmland, about two-thirds, is given

over to subsistence farming, a system where practically nothing leaves the farm, which only grows what the family needs for food, the family needing all that it grows. Subsistence farming is at once deeply rooted in the tradition of the people and at the same time isolation, difficulty of access and absence of communications largely force it upon much of the region, which remains for the greater part as isolated now as it was several centuries ago, and must even grow its own fibres for textiles. On subsistence farms the interest centres on rice, an almost universal staple in Southeast Asia, and only in the most congested areas, such as the Vizayas and Java, is there any well-established practice of growing some other food as substitute for rice. Rice dominates the diet even where local conditions do not seem favourable, as in the dry zones of Burma and Siam or in the relatively gloomy, rain-soaked areas immediately round the Equator. At least 90 per cent of subsistence farmland is under rice, the balance of supplementary food needs (coconuts, spices, fruits and pulses) occupying a very small fraction of any one farm and often being gathered wild rather than cultivated. The dominance of rice, even among the hill peoples, is the more remarkable because the plant was apparently introduced by Indian colonists some time about the middle of the first millennium, since when thousands of varieties have been evolved to suit the subtle differences of local climate, seasons and soil.

In total, Southeast Asia subsistence farming has continued with methods evolved locally centuries back. The hoe or mattock and the dibble are still the only soil-working implements in many areas, even on paddyfields, but ploughs of the soil-opening rather than the soil-turning type have become widespread, generally home-made and entirely of wood, that raw material ubiquitous in this terrain. With the plough came the need for draught animals and most subsistence farms now have one buffalo or ox per family, the former being favoured towards the Equator, the latter in the drier or more seasonal areas.

Commercial Farming

Farming for crops intended to be sold, that is, commercial or cash farming, came late to Southeast Asia. Except in one or two districts of the Philippines and Java, cash basis farming is scarcely a century old and many types of crude adjustment to this innovation

may be found. The oldest cash farming of Southeast Asia was the spice trade of the Moluccas, but even at its peak that trade involved very few areas given over exclusively to spices, which for the greater part were collected from farmers each with a tree or two, rather than a number of acres devoted to a crop of spices. The crux of the matter at that period was that nothing cultivated in Southeast Asia apart from spice was transportable to or of use to the world's population centres overseas. To a large extent over the present millennium Southeast Asia has been an absorber rather than a supplier of goods or commodities; only in the last hundred years or so has the condition changed, not so much by new demands for Southeast Asia products as for crops transferred to Southeast Asia for production.

Rice.—Commercial agriculture in the whole region occupies about 35 million acres and has taken two forms, both strongly influenced by European interests: farming food crops for sale, and farming non-food crops for sale. Of the food crops, sugar was the earliest successful innovation established in Java and the Philippines soon after European colonisation began, and intended for export to Europe. Today at least half the area devoted to crops grown for export is in rice and, taking into account the amount of rice grown for cash sales in deficit regions inside each territory, the proportion may reach as much as three-quarters. Upon commercial rice production depends the possibility of workers leaving their own farms and devoting their full time to non-food cash crops, so that the workers on rubber, cotton, hemp, coffee and sugar plantations have provided a great demand for Asia's staple cereal, supplies of which have been vital to the development of plantation and mining industries of Southeast Asia and, incidentally to the industrialisation of other parts of Asia. The bulk of the rice produced in Southeast Asia for export has gone to India and China, where a condition approaching the limit of rice-growing has been reached, and to Malaya and the Outer Islands of the East Indies. Japan too was becoming a major rice importer until 1941. All this rice export came from Burma, Siam and Indochina in that order of importance, territories which have pioneered in rapidly expanding commercial rice production to form the pool, the only rice-pool in the world, from which other areas have made up their deficits. Moreover the commercial production of rice in Southeast Asia has been steadily increasing over the last 20 years—the average

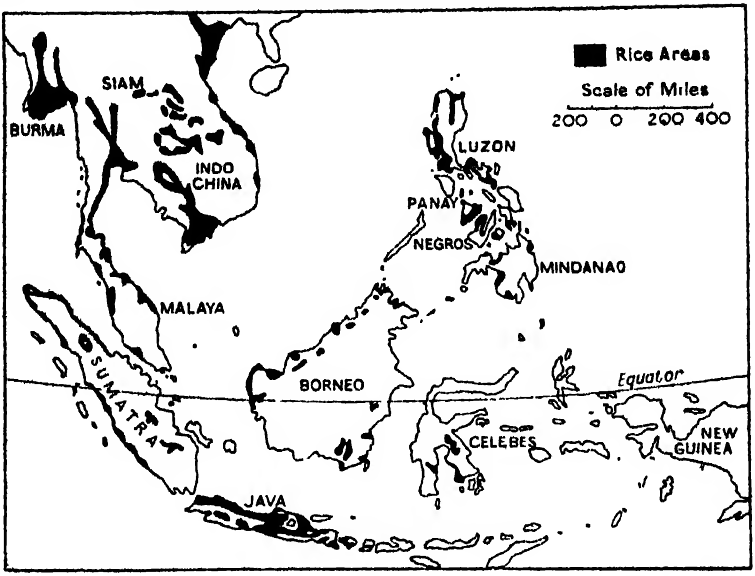

FIG. 112.—Distribution of Rice Cultivation in Southeast Asia

Southeast Asia acreage under rice each year of 1916–20 was 38.28 million, and each year of 1936–40 was 51.40 million. These figures of course include both subsistence and commercial production of rice, but they make it clear that by far the most important farming interest was rice, which covered nearly 95 per cent of cultivated land in Siam, 85 per cent in Indochina and 65 per cent in both Burma and the Philippines.

SOUTHEAST ASIA AREAS UNDER RICE (million acres)

	1914–15	1919–20	1924–25	1929–30	1934–35	1939–40	1944–45	1949–50
Burma	10.0	10.5	12.1	12.8	12.7	12 8	8.5	9.0
Indochina	10 4	11.9	11 7	14.0	13.1	14.7	14.1	12 0
Siam	5.0	6.1	6.8	7.5	8.1	8.8	5.5	12 4
Malaya	—	—	.6	6	.7	.8	.7	.9
Java and Madoera ..	6.9	8.8	8.7	8 8	9.9	10.1	7.7	9.7
Philippines .. .	2.7	3.6	4.2	4.4	4.9	4.9.6	3.6	5.7

SOUTHEAST ASIA RICE PRODUCTION (million metric tons clean rice)

	1914–15	1919–20	1924–25	1929–30	1934–35	1939–40	1944–45	1949–50
Burma	3.73	3.74	5.15	5.07	4.6	4.73	2.4	2.9
Indochina	4.32	2.96	3.54	3.67	3.4	4.00	3.6	3 6
Siam	1.93	1.41	3.08	2.41	2.86	2.86	—	3 7
Malaya	—	—	.24	.16	.33	.34	—	.4
Java and Madoera ..	2.88	3.64	3.43	3.38	3.54	4.09	3.5	4.2
Philippines	.05	1.02	1.28	1.44	1.28	1.5	1.1	1.6

Cash farming for rice is the only extension of a Southeast Asia subsistence farming crop into commercial farming on a large scale; only a negligible proportion of coconut-growing is for export, though this too, is an extension of Southeast Asia subsistence farming. It has been inevitable that subsistence farmers and the techniques they developed for rice have set the character of commercial rice farming which has been pioneered by local people and continues to be essentially a non-mechanised produce whose volume comes more from area and less from intensive farming.

RICE IN SOUTHEAST ASIA:
ANNUAL AVERAGES PER QUINQUENNIUM

Period	*Million Acres Under Rice*	*Production Million Tons Clean Rice*	*Net Exports from SE.A. (Million Tons Clean)*	*Per Cap. Utilisation (kgms.)*	*Yield in Tons per Acre*
1916–20	38.3	13.5	3.9	119	.352
1921–25	43.6	15.3	4.6	137	.352
1926–30	47.5	16.5	4.7	131	.348
1931–35	49.6	16.7	5.2	117	.337
1936–40	51.4	17.5	5.0	118	.339
1946–50	48.1	15.6	1.9	98	.325

For 1951 *it is estimated that Southeast Asia sowed about* 50 *million acres of paddy, probably producing* 16 *million tons cleaned rice. The exports may total* 3 *million tons. These figures suggest the consumption had declined to below* 100 *kgms. per person, but this is not reliable since unreported dealings were going on and reported facts were not necessarily the true ones.*

Other Food Crops.—The other commercial food crops, sugar, coffee, tea, cinchona and oil palm total much smaller areas than rice farming. Broadly, these innovations were developed by European colonial planters opening up what were very largely virgin territories, normally in the form of large estates calling for a labour force which derived only in part from local people, the rest being obtained by introducing labour from outside. In the Philippines and in Java the first European essays in agriculture caused serious interactions on local land customs; in Siam an aristocratic feudal system enabled commercialisation to be introduced without external intervention. These crops tended to be perennial cultivations, taking advantage of the continuous growing season of the region. In due course this has led to a large production, causing the external price to drop, especially as there has

been similar commercialisation of the same crops in other tropical areas, all quickly reaching large-scale production of commodities which began as expensive luxuries and gradually cheapened to become low-priced semi-staple foods not offering any prospect of large returns for nominal outlays. Rivalries with other producing areas and speedy saturation of the world market has so far given these types of commercial agriculture a confused history of boom and depression, of rapid extension and then dereliction or scientific experiments to cheapen production. In these crops, techniques and methods more western than eastern have been used though mechanisation in the field has not been possible owing to the nature of the crops. The processing involved has often been modern and highly mechanised.

Rubber.—Commercial production of non-food or industrial crops in Southeast Asia has centred on rubber. Rubber has been an innovation peculiar to Southeast Asia (Central Africa and Ceylon took it up later) and its cultivation proved a remarkably successful transfer of a tree from another part of the tropics, developed here on plantation mass production lines, whereas in its original habitat the tree was wild and tapped on the "gatherer" system now only used for gums and damars collected from forest trees. Upon Southeast Asia rubber has depended the popularisation of the petrol driven vehicle, the incentive to petroleum production and the development of world road systems. Its cultivation was on the European orchard pattern and at first it was only possible by companies sufficiently capitalised to wait 7 to 10 years for maturity and to recruit labour from other regions to make the plantations in virgin areas, at a distance from subsistence farmers or cash farmers of foods to suit the plantation workers. Smallholders gradually took up rubber planting as an adjunct to other crops and as part of a mixed farming system. Reversing the history of rice agriculture, rubber started as a large-scale plantation cultivation worked by non-indigenous people and gradually moved towards a smallholder, mixed-farming type. Altogether, some 6 million acres of Southeast Asia are in rubber, the greatest single block being in Malaya. Rubber, too, is a perennial and a long-term crop and its history has been an alternation of high prices and low prices, and of rapidly saturating the market which has throughout been external to Asia. Malaya, by almost exclusively specialising in rubber, proved very highly geared to

external events and their effects on rubber price, to a degree not paralleled by other types of Southeast Asia farming which were, during a crisis, more closely related to subsistence farming and thereby buffered from external valuations.

TRENDS IN AGRICULTURE

Several long-term tendencies in these various farming types have become apparent. For all the commercial crops except rice, external events have obliged experiment and development towards higher and higher production per unit area; yields for commercial crops have progressively increased. In rice farming, however, methods have continued to be extensive, yields have steadily decreased and there has been little advance in either maintaining fertility standards or increasing the yield. Experimental farms exist throughout the territory to promote these improvements, but they have made little impression on the rice-farming community as a whole.

RICE YIELDS IN SOUTHEAST ASIA (hundred lbs. milled per acre)

	1934–35	1939–40	1944–45	1949–50
Burma	8.2	8.4	6.5	7.0
Indochina	5.7	5.5	5.6	6.6
Siam	9.1	8.6	7.5	6.6
Malaya	9.7	9.1	—	10.7
Java and Madoera	9.3	10.0	—	9.5
Philippines	5.8	5.8	6.8	6.6

By the quinquennium 1936–40, annual yields had declined nearly 4 per cent from those of 1916–20 and production had increased solely by increasing the acreages, whose annual average for the same quinquennial periods increased by 34 per cent.

The general movements of rice in Southeast Asia are evident from the table on page 356 which summarises surpluses and deficits over a period.

Commercial rice production was associated almost exclusively with the expansion of agriculture to the deltas of the Irrawaddy, Chao Praya and Mekong and in varying degrees to increased control over flood waters. It is in this large-scale water control that the greatest long-term changes have been set going by western engineering techniques coping with the wide range of circumstances under which Southeast Asia floods occur. Effective

small-scale water-control methods had in fact existed in this region before; the earlier technological interest was to expand rice production by increased water-control on specially fertile, generally volcanic, upland soils. The objective then and now was the same—to cultivate the most fertile areas; the difference was that the volcanic soils attracted local attention and were within the capacity of local people, considerably earlier than the deltaic soils.

SOUTHEAST ASIA RICE EXPORTS AND IMPORTS
(million metric tons clean)

	Exporters				*Importers*	
	Burma	*Indochina*	*Siam*	*East Indies*	*Malaya*	*Philippines*
1915	2.12	1.09	1.0	.55	—	.22
1920	2.0	1.09	.25	.22	-	.07
1925	3.32	1.33	1.18	.50	.41	.10
1930	2.95	1.02	.93	.62	.60	.01
1935	2.93	1.52	1.38	.36	.48	nil
1940	2.50	1.40	2.00	.06	.70	.1
1950	1.17	.09	1.48	.28	.50	.16

A further process at work has been a decline in Southeast Asia consumption of rice per person over the last 30 years, which made possible the expanding exports of rice at a time when population was rapidly increasing. The declining consumption seems to be due to slight changes in diet habit; maize, potatoes and tapioca have steadily entered into local meals and the proportion of vegetables has increased, more especially as it has come to be realised that the dietetic value of meals exclusively based on rice, the custom in Southeast Asia for a long time, is low, as indicated by the small stature and delicate bones of Southeast Asia peoples.

Commercial agriculture has largely revolved round tree cultivation (arboriculture rather than agriculture) in which the continuous growing period produces maximum effects. In this tendency may be seen a return to the tree vegetation which is indigenous to equatorial Southeast Asia, and away from the annual and deciduous plants more suited to ecologies associated with the seasonal margins of the tropics. Labour difficulties too are eased to some extent by tree crops whose periodicity is better spread than in the case of annual crops. To the labour difficulty also is due the trend towards devolving arboriculture from plantation systems

to smallholder systems, leading to the smallholder becoming an exponent of diversified rather than single crop cultivation.

While the region has sought to escape the consequence of overmuch dependence on one or two cash crops, Southeast Asia subsistence farming is really already highly diversified. Moreover, the region as a whole must be considered reasonably well diversified in the range of commercial crops it produces, even though individual districts within Southeast Asia are monocultivated rather than polycultivated.

Effects of the Second World War

During the 1941–42 campaign, battles were fought through Burma, Malaya and the Philippines. More military action took place in Burma and the Philippines over the year 1944–45. The direct long-term effects of these campaigns were not emphatic because agriculture and arboriculture cannot be "scorched" and denied to the enemy on a large scale. The war in these territories devastated internal communications, broke down the systems of internal trade, removed the means of communication between different parts of Southeast Asia and destroyed the channels to those overseas markets which had been the principal destination of commercial agricultural produce. Breakdown of external trade channels occurred in all Southeast Asia territories whether campaigns took place in them or not.

The first consequences of this disruption, as distinct from destruction, were to place a premium on subsistence farming, to cause all commercial cultivation to fall into desuetude, to undermine confidence in agriculture for cash, to cause the loss or destruction of draught cattle which were taken away for military use, to disperse labour forces, and to stimulate self-sufficiency policies. Very little of the perennial tree acreage, such as of rubber, was cut down—only 6 per cent in the case of Malayan rubber—yet it was the commercial production which suffered most from disruption, which created in the postwar period considerable difficulties for those territories needing imported rice for the labour to rehabilitate commercial farming and industries. Agriculture itself, where labour was available, rehabilitated quickly; all but 2 per cent of Malayan rice acreages were back in cultivation during 1945–46 and rubber made an equally quick comeback, so

that about one-third of its prewar estate area was being tapped in 1947, representing two-thirds of the area tappable.

In the food crops, surplus margins were more slowly restored. Exports of Southeast Asia rice totalled about a million tons during 1946, as against a combined export of 5.7 million tons annually for 1936–40. The drop in production of this staple was greatest in the case of Burma because there the dislocation by war had been greatest, but by the 1946–47 season, about two-thirds of Lower Burma rice acreages were back in cultivation, as against half in 1945–46. In Cochinchina over 70 per cent of the rice area was being cultivated in 1946–47. Siam which was untouched by military campaigns reported 10.6 million acres under cultivation in rice for 1946–47 (22 per cent more than 1939–40)—the only territory to show a substantial increase of rice acreage in the immediate postwar years.

A postwar feature has been the general decline in rice yields, mostly an effect of loss of draught cattle, though to report low yields was a convenient cover for black market sales. The consequence of lost production in local food was felt more in places like Malaya which has specialised in non-food commercial agriculture, than in any other territories of Asia, which customarily needed to import only a small margin and not the majority of their rice. For the Philippines in 1947, the United Nations reported that *per capita* consumption of rice was actually higher than in 1939 by about 5 per cent.

Since labour shortage has been prominent as a factor operating against postwar commercial agriculture, the subsistence farmer and the diversified smallholder have assumed far greater significance than before. Over 55 per cent of Malaya's rubber production for 1946 was from smallholders, a proportion which had been as much as 85 per cent in the early months of that year, yet fell to 45 per cent in 1950 (cf. 39 per cent in 1940).

The vegetable oils soon came back into production and by early 1947 monthly production in Southeast Asia was not far short of 1941 production and now exceeds it.

The general lowering of food acreages and of yields, combined with the enforced reversion to subsistence agricultural forms, has a special significance for Southeast Asia food supplies over the next few years, because the restricted food supply comes at a time when population is rapidly increasing, at the rate of about 20

million people per decade, and when social policy is for raising the standard of nutrition. These two factors mean that the pre-war rice exporters are on every score likely to continue to have less margin for export. How the communities will meet this basic difficulty of supply in their staple food is not clear ; mechanisation is scarcely a solution, yields are very difficult to raise on a large scale, and there are few unused areas of high potential for rice farming, yet unless improvement is reached the labour force is unlikely to remain in non-food producing territories, rice may be for such areas a luxury and not a cheap staple, and the costs of any production must remain high. Influences of this sort in a region where average productive skill is low and slow, may cause it to become one of the world's most costly producer zones and hasten in Europe and the United States the exploitation of substitute commodities which lend themselves to mechanisation more than is the case with typical Southeast Asia agricultural products. It may happen that rapid peopling of Sumatra, Borneo and New Guinea deltas may take place, much as the continental deltas of Southeast Asia were quickly filled with people over the last 50 years; the fact that there has been previous reluctance to go to these places is no guarantee that there will be continued reluctance. Southeast Asia may even become a consumer for rice cultivated in the new areas of South America and Northern Australia. Perhaps some startling innovation of crop or technique will change the otherwise rather gloomy picture, much as the opening up of Canadian, Australian and Argentine wheatlands speedily altered the similarly gloomy outlook for European wheat-eating peoples at the end of last century.

Directions in these trends of Southeast Asia agriculture are difficult to determine because there are major stratifications of local society both vertically and horizontally which are in process of readjustment, aggravated by currency confusion and widespread ignorance. These will take time to reach an equilibrium and during that period subsistence farming and its nationalist corollary, territorial self-sufficiency, are likely to be strong influences working against a great revival of commercial activity of any sort, with the result that Southeast Asia may not continue indefinitely in its prewar role of one of the world's major sources of supply. Against this must be weighed the proved ability of tropical agriculture to respond quickly to new impetuses.

Chapter Twenty-three

THE FISHERIES OF SOUTHEAST ASIA

The Fish Population

Because equatorial waters have low salinity and low oxygen content, it has frequently been assumed that they have a low fish population. That view is difficult to maintain for the shallow waters of Southeast Asia where, according to Herre, the number of kinds of fish and their diversification is unrivalled by that of any other marine region. Whether this paradox disproves the theoretical view about equatorial seas or shows that the fish population depends more on the local supply of nutrients which so broken and well-watered a region as Southeast Asia discharges to the sea in extraordinarily large quantities, has yet to be demonstrated. There is no co-ordinated study of the fishing industry as a whole in this region.

Until recently, only the generic character of these Southeast Asia fish had been studied, from which it appears that, while by no means all of them have been named and identified, over 1,500 varieties are normally fished round Java, over 500 have been named as economically valuable round Malaya, and similar large varieties are reported from all territories. Most of the fish known are inshore fish, closely dependent on food particles carried from shore to sea and on the great growth of plankton, seaweeds and corals which supply fish food. Because the shores of the landmasses in most of this region are frequently backed by swamps, there is a very considerable fish population on the land surface itself, in a gradual transition between shallow water marine fish and swamp or riverine fish. Thus the fishing industry is not merely an inshore activity: it continues very vigorously inland, in the swamps, in the flooded paddyfields and their canals, in the lakes and lagoons, and in the rivers.

Though the deep-water fish of Southeast Asia have only in recent years been exploited commercially, by Japanese trawlers, they exist in these waters in surprising numbers. Schools of sardines some 10 miles long have been seen, together with frequent

great shoals of mackerel and bonito. Porpoises (mammals which live on fish and are a guide to the fish density) have been seen in a school which packed an area 15 miles long and 2 miles broad. Plankton occurs at times in astounding quantities, practically smothering all other fish life in the neighbourhood. The movements and migrations of these fish of deeper waters have been little studied and the inshore fishing has been enough to meet local food needs, as well as not demanding too complex a technique or too great a capital outlay by the local fishermen who are generally very few, and too poor to equip themselves for long distance deepwater trips. A major impediment to introducing the elaborate systems of trawling and seining which have been developed in temperate seas is the frequency of coral reefs and knolls which, although attracting fish, catch the nets and ruin them.

Fish as a Staple Food

Fish is a staple in the Southeast Asia diet as complement to rice. It supplies calcium, iodine and salt as well as animal protein, items otherwise not easily come by in these areas, or too expensive for the peasants. By habit Southeast Asia people are rice-fish-curry eaters and vegetables in the European sense enter very little into their meals. They are largely vegetarian but not interested in vegetables. Fishing has an importance in local ecologies second only to rice. In Malaya, for example, well over 80 lbs. of fish is normally consumed by every man, woman and child every year. When looking through the records of any one territory, however, the great significance of fish is not apparent because fishing is a mobile and widely dispersed activity not easily checked, the more illusive statistically because it plays little or no part in revenues.

Several stages of commercialisation are met with but subsistence fishing predominates. In every paddyfield and swamp, villagers go fishing for their personal needs; on the coast many fishermen are part-time, sharing their labour between a paddyfield and a fishing boat. Some villages have specialised fishermen whose produce goes into exchange among the landsmen to make the village self-supporting. Gradually fishing for sale has become possible, yet there are major difficulties of transport to consuming centres, of organisation between fishermen and consumer, and of preserving the fish in good condition during transport.

Trade in Fish

Apart from that fish eaten fresh on the coasts, the bulk is preserved for commerce and for storing during seasons when the sea is too violent, by sun-drying, salting or by conversion into one of the highly-spiced, partly-fermented fish sauces widely admired by Southeast Asia people (i.e. *blachan* in Malaya, *trassie* in Java, *nuoc mam* in Indochina, *kapi* in Siam, *ngapi* in Burma). Huge quantities of fish in these forms move inland within each country and there has developed a considerable movement of preserved fish between the different Southeast Asia territories, to supply the plantation and industrial workers. From Siam and Indochina alone preserved fish to the value of about $12 million was exported each year before the war. That fish preserving is widely practised even for local use means that the activity is very largely buffered from the alternations of glut and scarcity which are common in fishing industries. The transport of the preserved fish both internally and externally tends to be by sea for cheapness, a paramount consideration in a food for peasants, and because there are few alternatives. Only in a few areas is there a speedy land service able to deliver fresh fish to inland urban centres.

Commercialisation of fishing has brought in foreign personnel. Whenever fishing is carried on for export as cash-sales, Chinese are frequently the principal fishermen, as at Bagansiapiapi (Sumatra) and Pangkor (Malaya), in the deep-sea fishing centred on Singapore (once associated with the Japanese) and even in the cultivation of fish in Javanese ponds. Moreover, Chinese are strongly represented as the middlemen who handle the trade from the actual fisherman to the ultimate consumer, and they are generally responsible for processing the wet fish into transportable forms.

Freshwater Fishing

While the absence of deep-sea and mechanical mass fishing methods is one peculiarity of Southeast Asia, equally remarkable is the emphasis on freshwater fishing. Very largely the methods of freshwater fishing—traps and small nets—have established the styles used for inshore sea fishing. For the most part the value of this freshwater production cannot be gauged though it has major importance in local diet. Two variations of freshwater fishing

have exceptional interest. In Indochina the Tonle Sap fisheries represent the most productive of the natural fresh fisheries, and in Java has been developed a large cultivation of fish in ponds.

From Tonle Sap over 25 tons of fish are produced annually from each square mile of its surface, a productivity ten times greater than that of the well-fished North Sea of Europe, and unique in its intensity. This exceptional production is possible because the large area covered from early June by shallow floods enables fish to spawn profusely in about 3,000 square miles of inundated forest, where abundance of vegetable matter makes the fish grow larger than those in any of the neighbouring rivers. Over 30,000 persons are normally fishing this lake and the full-time fishermen live in villages of pile dwellings scattered round it; of these lake-side fishing villages Snoc Trou is the most important. A considerable number of migrant fishermen, Annamese, Chinese and Malay, move into this area temporarily for the peak fishing season from October to January. Over 135,000 tons of fish are obtained annually and half of this is dried before leaving the region; some fish are sent alive towards the estuary of the Mekong in floating cages of bamboo enclosing what is virtually an artificial shoal moving through the water to the market, an ingenious device for transporting live fish. The commercial side of this fishing is almost entirely Chinese. Over-fishing has been going on in recent years and controls are becoming necessary.

In Java two types of pond fishing have been evolved. Near Batavia, Sourabaya and Semarang where the demand for fish is great, mangrove swamps are partially enclosed to control the tidal water and into the enclosures are placed, between April and July, the spawn and young sea fish gathered among bundles of leaves which fishermen have previously placed in the open sea for the purpose. The spawn and young fish are carried to the fishponds in jars and there left to fatten on algae and water weeds cultivated for them. The milkfish (Chanos chanos) is popular for this purpose and reaches marketable size within a year. Elsewhere inland artificial freshwater ponds have been built, covering a total area estimated at over 100,000 acres, in which fish of the carp type are bred and fattened all the year round, 65,000 tons of fish are obtained every year by this means. Freshwater fisheries are now encouraged in every little tank or pond as a form of mosquito control.

Inshore Fishing

Inshore sea fishing is by far the most usual in Southeast Asia. The boats used are generally very small, often needing only a man and a boy to work them, indicating the small units of the industry. Land and sea breezes play a key part in the rhythm of activity, being the source of power to and from the shore. It is unusual for the boats to move more than a mile from shore and rarely do they lose sight of land. Much inshore fishing is done without boats at all. The beaches are netted by fishermen moving waist deep through water and, wherever fish are known to migrate along the coast, barriers of bamboo are built out, leading the fish into a square enclosure or trap from which they are periodically drawn up in a net by a fisherman who lives with his family on a platform above the trap. Probably three-quarters of Southeast Asia sea fishing is done where the sea is less than 10 ft. deep. The fish thus obtained tend to be of the small type and a large proportion are crustacea, much favoured in local diet. Huge quantities of crabs, shrimps and mussels are obtained, and squids are regularly netted in large numbers for local use. The shells of crustacea are ground to powder and used in conjunction with the areca nut as a favourite old-fashioned chew common to the whole region. Because coastal fishing takes place so close to the shore where breakers are violent, it is markedly seasonal in character, depending on aspect relative to the seasonal winds. This seasonality is a great incentive to preserve the fish to last through that season when the little fishing boats cannot cope with the heavy seas. Inshore fishing closely relates to the shallow waters of the Sunda Platform; where the coast drops away to great depths, the intensity of fishing diminishes.

Distribution of Fisheries

While fishing commands a wide interest, it is by no means uniformly developed through the region. Broadly, the coasts near densely populated areas are the most intensively fished and estuaries and deltas have major fishing developments, though neither at the Red River mouth nor the Irrawaddy mouth has fishing reached a high pitch of development. The Mekong, particularly at the seasons when the Tonle Sap water is discharging, has great attraction for fish and the whole coastal zone from the Mekong

round the Gulf of Siam to Singapore is well fished and is one of the few known tracks of fish migration in these seas, possibly relating to the southwesterly drift of the Mekong discharge. The Malacca Strait also has vigorous fishing industries, associated with the fishing at Bagansiapiapi and Pangkor which have been commercialised by Chinese. Along both sides of the Malacca Strait fish traps stand out from the coast almost continuously for mile after mile. Bagansiapiapi fish comes almost entirely from traps set across the creeks of the Rokan River. In the Philippines, themselves spread athwart the equatorial currents of the Pacific like a great trap, the annual catch of fish exceeds that of any other territory, yet the Philippines import much canned fish in addition.

For most Southeast Asia countries information about the significance of fishing activities is sketchy, although in every case fish ranks high in the basic foodstuffs. The total activity in fishing is enormous; probably 3 million people are engaged in Southeast Asia fishing and the amount of internal trade in fish must total far higher than so widely dispersed and so little commercialised an industry might at first suggest. There is always a substantial movement of fish in various forms from the coasts to the interiors and from one territory to another, as the following points indicate:

Burma.—That Burmese developed their tradition well in the interior may explain why it is only in Arakan and Tenasserim there has been intensive sea fishing. Within the Irrawaddy distributaries South Indians have taken to fishing and they deliver fish on ice to the rice farmers of Lower Burma, whose diet is more monotonously rice-and-fish than is the case towards the interior. The Buddhist tradition causes Burmese to disrespect fishermen on the grounds that they are responsible for the destruction of many living creatures. From Tenasserim and Arakan, surplus fish is exported to Malaya and India respectively, the total value (over 1935–40) being of the order $115,000 annually, of which Malaya takes over three-quarters. In net trade Burma is a fish-deficit area, importing over $3½ million of fish (about 12,000 tons), 60 per cent from India.

Malaya.—About 100,000 tons of fish were regularly landed on Malayan coasts by some 20,000 fishing boats (1950) chiefly on the coasts of Selangor, Perak, Trengganu, Pahang and Penang. At Singapore heavy prewar landings were accounted for by the deep-sea trawl-fishing done by Japanese crews working at long range

among the remoter islands and off Borneo. In addition to this home production, over $9 million of fish (1947) was imported dry from the East Indies, Siam and Indochina, mainly as part of Singapore's entrepôt trade; only a small portion of this import was consumed in Malaya.

In Malaya and Burma pond cultivation has been negligible.

East Indies.—In Java intensive fishing is carried on, though its coast is small in proportion to its population and production has rapidly become inadequate, in contrast with the thinly-peopled coastlines of Sumatra, Celebes and Borneo. Java's fishing concentrates upon the northwest coast where 21,000 tons were caught in 1940; farther east along the north coast fishing diminishes. A large part of the catch moves to West Java and the Outer Islands for the plantation workers. Since 1900 the interest in fishing declined until Java became no longer self-supporting in fish and imported from Siam and Indochina which together supplied about 45,000 tons annually in the seasons 1938–40.

To establish commercialised fishing in the Outer Islands was no easy matter, but in Sumatra and Borneo a start had been made. At Bagansiapiapi about 12,000 Chinese had established a large fishery producing annually about 35,000 tons of fish which went to Java (60 per cent), Singapore, Penang and Malacca. To salt the fish nearly 20,000 tons of salt moved into Bagansiapiapi. In Borneo, Soekadana on the west and Pegaban and Kotabaru on the east were fishing centres, supplying the interior and exporting yearly about 4,000 tons of dried fish to Java; Macassar functions as a market for pearl and shell fishing and for the *abalone* (Holothuria) catch of the eastern seas besides exporting annually about 1,300 tons of *agar agar* (a seaweed for jellies).

To Java and Madoera just before the war 49,000 tons of cheap fish were imported from Siam and Indochina by way of Singapore, 46,000 tons from East Sumatra, and 8,000 tons from other Outer Islands. The home catch of sea fisheries totalled about 94,000 tons per annum, and fish weighing nearly 30,000 tons (1947) was obtained from ponds and rivers. Lake Tempe (South Celebes) has been intensively developed for inland fishing and 3,000 tons of dried and salted fish were exported from that district in 1946.

Indochina.—Although the physiography of the Indochina coast appears to favour sea fishing, yet coastal fishing interests local people less than the inland fisheries. A luminant oil for peasants

is extracted from Indochinese fish. Salt water fishing produced 150,000 tons annually before the war. Only along the Annam coast, particularly near deeper waters round Tanh Hoa, is inshore fishing very active on the basis of trawling and seining, which are unusual styles for Southeast Asia. The Cambodian coast, meeting place of migrant fish from the Mekong mouth and the Siamese and Kra coasts, produces fish of exceptional size. The Mekong distributaries are also considerably fished to supply the Saigon and Cochinchina markets. Of the freshwater fishing that in Tonle Sap is the best known and most productive, but there are others well developed in the streams of Tonkin and along the Mekong, where oxbow lakes and artificial ponds are used for seasonal fish cultivation.

Fish products rank high in Indochina's exports, though valued only at one per cent of the total exports. Shipments usually go to Malaya and averaged 37,000 tons per annum for the period 1939–41, but they were valued at $2 million in 1950.

Siam.—Every Siamese is said to eat some fish with every meal of rice. At any rate the Siamese consumption of fish is estimated to be larger than for any single Southeast Asia unit. Much of the fish comes from inland fisheries and the floods of the Chao Praya and the Nam Mun create natural ponds which last long enough to fatten many fish. These inland fisheries are not well documented. Fishing is taxed according to the implement used rather than in relation to the amount caught, yielding a revenue of $.9 million (1944). Siamese sea fishing provides that dried fish which is exported. Mackerel, sardine and pilchard types migrate along Siam's attenuated coast and they are exhaustively fished as a whole though individual fishing units are small and poorly organised. At certain seasons the sea offshore is almost solid with squid which are caught in large numbers for eating. Probably 43,000 tons of fish are annually salted on the coast for transport and trade, but poor organisation and careless salting with low-grade brine taken direct from the sea has given Siamese fish a low reputation; it ranks as the lowest grade of salt fish in Southeast Asia markets. The export usually ranks at about $2.5 million annually (100,000 tons 1941), going to Singapore, Penang and Hongkong, largely for re-export from those places. Because the local fish is inferior, higher grade fish are annually imported from surrounding areas to a value of some $1.5 million (1950). The fish

trade was largely Chinese, but Japanese fishermen had pirated the coast for years, using large trawlers serving markets in Singapore and in Japan.

Philippines.—Fish is as important in Filipino diet as in that of peoples on the mainland, and it is likewise an inadequately documented phase of their activities. Only in 1939 was a census of fishing taken. The amount that went into inter-island trade was small compared with the catch and only 100 out of the 1,600 types of local edible fish were marketed. Filipino fishing resembles that elsewhere in Southeast Asia and both inshore and inland methods are used. In the last decade also, some deep fishing had developed and steam trawlers landed quantities of *bonito*. Deep-sea fishing centres on Batangas, Manila and Sulu, whereas the inshore types are most developed round Mindoro, Batangas and Bulacan. More than 90 per cent of inland fishing (from rivers, ponds and lakes) comes from Batangas, Bulacan, Laguna and Rizal. The Pampanga and Iloilo districts have many fish ponds. Pearl oysters are gathered sporadically round the Palawan and the Sulu Islands.

In 1939 about 180,000 Filipinos were fully engaged in fishing and another 200,000 fished part-time. The total catch was then valued at $150 million. Fish had no significance as an export and about 400,000 tons were imported in 1940.

Postwar Fishing

Casually organised and producing a poorly graded commodity Southeast Asia fishing has everywhere an important place in the diet of local people. The international trade in fish within the region has certain resemblances to the rice trade in direction, in variability from year to year, and in foreign monopolisation of the middleman function and trade organisation. On the other hand, the dispersed and loose organisation of Southeast Asia fishing proved an advantage in the war period. Its simplicity of operation, use of locally-made boats for fishing and bulk transport, and ease of replacement of locally-made equipment, meant it suffered lightly from the war.

The fish trade between Southeast Asia countries was, however, paralysed, owing to difficulties of procuring bulk salt supplies and of transport, but the rice-eating people in rural areas were not seriously deprived of their supplementary fish, so much of which was caught nearby. The large towns which once consumed fresh

fish trawled at a distance or brought on ice from the coast could not receive adequate supplies and suffered accordingly until transport became easier. Java suffered most from the breakdown of international fish trade because no other Southeast Asia territory normally imported such large quantities of dried fish.

Chapter Twenty-four

INDUSTRY AND TRADE IN SOUTHEAST ASIA

If "industry" be taken to include all activities connected with processing, then there is more industry in Southeast Asia than appears at first glance, though not much manufacturing in mechanised factories may be found. The territory is, however, overwhelmingly agricultural and in almost every part of the region it is subsistence agriculture which employs and sustains the largest number of people. Much manual processing is done by these subsistence agriculturists on their own little farms to prepare their production for their family consumption.

Cottage Industries

The tradition of being self-supporting in each territory, the national counterpart of individual subsistence farming, is very strong even today, finding expression in the widespread cottage industry of weaving and in that Southeast Asia custom of making a single length of span-broad, hand-made cloth the basis of a skirt-like dress—the *sarong*, *lungyi*, *panung* and so on. Today this domestic weaving, where it has managed to persist in spite of competition from cheap imported cloths, uses imported cotton yarn, although parts of Burma still weave homegrown silk, and Siam and Indochina continue home-weaving on the basis of Indochinese silk. Only in Java has the "cottage industry" become elaborated into a village factory industry for a more intensified and commercialised production of sarongs. Ninety-two per cent of Java's *batik sarongs* (printed cotton skirts worn by men and women alike) come from factories of less than 80 workers each; this specialised process of dyeing in patterns defined by wax is now done by the small factory working upon imported cotton cloth.

The other considerable domestic industry deriving from the subsistence tradition is that of making innumerable varieties of articles from plaited palm leaves. Containers of many sorts, hats, domestic utensils, house walls, mats, fish traps and agricultural

tools are all made by villagers using the palms and bamboos of their setting. Boats, shoes and tools are made of wood by peasants, mostly for their own use. While this type of industry usually secures no place in national statistics and has low monetary value, it plays a most important part in Southeast Asia life which may be described as still in the "Wood Age" so far as most peasant and rural life is concerned. Domestically-made cigars and cigarettes supply local needs and rapidly displace the *areca* or *betel* chewing habit. In Burma, the Philippines and Java cigar-making has become commercialised for trade and export; in Java some $9 million of hand-made cigarettes entered trade during 1937.

Throughout the region, too, are scattered remnants of a metal-working industry, as in the beaten silver of Malaya and Java, the niello work of Siam, and the gold settings for precious stones in Burma.

But these domestic industries rank as small by external standards and they play a negligible part in international trade. They must not be forgotten, however, because in the evolution of Southeast Asia we may see grow up forms of industrialisation originating in these domestic industries, as has been the case in the industrial evolution both of Europe and of the Far East. In these domestic industries little or no money is involved. At their simplest they are "subsistence industries" providing the family needs and scarcely anything more.

Thus most Southeast Asia people produce what food their families need and what articles they need. Their requirements from outside are very small and in any case their way of life involves so little money that they have small means to buy anything outside their local subsistence ecology. That was the earlier condition everywhere in Southeast Asia before the industrial revolution in Europe, and it continues both in the simple form and in many variations even today, when there have evolved groups of people in Southeast Asia who are entirely dependent on wages to buy food and what other articles they need. The subsistence principle is still strong in that very little money interchange goes on among the great majority of the population; some of them by doing part-time work earn wages, yet the money they earn has a very low average, indicated by the very low per capita revenues of the various states. Just before the war, Indochina revenue

averaged below $2 per person per annum and revenues were of that low order for all Southeast Asia countries except Malaya, where it was about $70 per person, a sign that Malaya, of all these countries, was the one where work and activities centred on money and had moved farthest from the subsistence principle.

It has to be noted that the small amount of money involved in such ecologies does not mean poverty in the European sense : it represents only that margin of necessities which is outside the subsistence ecology. In addition to the little money it obtains, each family in general has both its food and its domestic equipment produced by itself, or in conjunction with helpers from the village community. This is a state of society long since outgrown in Europe though we have to allow for it in every phase of Southeast Asia industry and trade and to assume it will continue to play a part in future changes.

Agricultural Processing

Because Southeast Asia is so overwhelmingly agricultural its mechanical industries relate largely to agricultural processes. Rice mills, sugar mills, starch factories (from sago and tapioca) and sack factories, have all grown up in connection with agricultural processing in every one of these territories. In addition, rubber factories, oil presses and sugar mills have been established on western lines in association with European-style agricultural developments. The fabrication of rubber has not gone far within this region; tyres have been made in Java where also mass-produced rubber shoes were made for Southeast Asia markets. For the most part, mechanical processing industries are located peripherally to the countries concerned and they operate primarily for immediate export, though small rice, brick and sugar factories have spread inland away from coastal sites.

Textiles

Apart from food, the chief personal need of Southeast Asia people is cloth and the demand for textiles ranks as by far the greatest single item of fabricated goods. Most of the textiles recorded are imported; the domestic industry has tended to disappear except in the remoter districts, and textile factories have not been set up to any extent within Southeast Asia. Cotton spinning at Semarang, Tegal and Damak and some 200 small

weaving factories in Java, were the leading developments in local textile industries, but the bulk of cloth and even of raw cotton has been brought in from abroad. Just before the war Southeast Asia was absorbing textiles to the value of well over $300 million per annum; much of it was cheap cloth from Europe, India and Japan, but there was a substantial need for the very finest cotton cloth produced anywhere and quite an exacting local standard of qualities. Should this huge demand for textiles stimulate local industry within the new nationalist units, Burma, Siam and Indochina may improve the quality and output of their present scanty and very inferior raw cotton.

Road and rail management, engineering maintenance and port industries form a leading group of mechanical industries directly affecting local techniques and introducing forms of industrialisation on western lines. The capital equipment for these activities is imported as are nearly all metal manufactures for other purposes. Manufactured goods form the largest single category of goods moving into Southeast Asia, to a total of nearly $500 million annually before the war. These manufactured imports chiefly went to urban consumers, yet simple farming tools and articles like needles and scissors went in large quantities far into every country. Although this category was broad, the components were very varied so that the value of each ranked comparatively low. Manufactured articles of western type showed little sign of being made locally, except in Java where successful attempts at making electric equipment had gone on for some years to supply the Southeast Asia markets with very cheap electrical goods like lamps and filaments, suggesting the possibility that Java may become industrialised on the Japanese pattern for mass production methods, and using part-time or women workers. In neighbouring territories, however, there are no such immediate prospects because labour has proved costly in proportion to its skill.

Mining Industries and Prospects

Mining industries of great value have developed in Malaya, Burma, Sumatra, Borneo, the Philippines and the small islands east of Sumatra. Tin and petroleum have been the region's specialities so far and these have assumed great importance, combining to be chiefly responsible for the prewar annual exports of about $650 million of mineral products from Southeast Asia

to the rest of the world. Iron ore and bauxite occur in large quantities, but without location convenient to the power needed to develop them. Gold has had special significance in Philippines mining, yet though found at many points, it ranks low for the region as a whole. Both tin and petroleum give rise to processing industries of smelting and refining which take place close to the streams of international traffic, particularly associated with Singapore and Penang. They play little part in local life, employ few people and go on at isolated points.

These mineral industries (which employed less than 250,000 persons before 1941) suffered from the war both by destruction in denial action and by neglect, so that they practically started anew from 1945. Whether they will all return to their prewar status remains to be seen. Southeast Asia provides the most prolific source of petroleum accessible to the Indian and Far Eastern markets and the wells are rapidly re-opening under the international oil groups which own them (output 1949, 9 0 million tons). Tin is coming back into production again more slowly because it needs more capital equipment such as pumps and dredges, which cannot be readily obtained, and there are some doubts whether world need for tin is likely to continue as great as before. The length of life of Malayan tin mines, the main prewar source, has been questioned, yet the little-known islands just south of Malaya are thought to contain extensive deposits of untouched tin likely to come into production in due course, though carefully screened for the time being from prospectors by local authorities. By 1950 the total tin output of Southeast Asia was about 99,000 tons.

Labour and Power for Industrialisation

Whether intensified industrialisation of Southeast Asia on the basis of these minerals is possible, turns upon two factors. Labour continues to be scarce; many prewar mining labourers dispersed during the war years when mining stagnated, and any immediate diversion of labour from agriculture to mining, even if possible under the tight ecology of the prevailing sub tence farming, is likely to prejudice local food supplies which pend basically on hand-grown rice.

Furthermore, Southeast Asia has limited so es of mechanical power, a factor not only of consideration r g expansion of

industries derived from mining, but also regarding the general prospect of local industrialisation. While good qualities are mined in Tonkin, coals of most Southeast Asia territories are of inferior grade and ill-suited to major industrial uses. This is an obstruction to developing the extensive iron ore deposits because only Tonkin coal can be used for smelting. Mineral oil does not suit heavy industrial processes though diesel type heavy oil engines are widely used in existing local industries, and will probably be the source of power for any new dispersed industries.

Water power resources are huge and widely distributed. So far only minor harnessing of water has been done and it is remarkable that, although Southeast Asia people have evolved skilled techniques of using their water supplies for agriculture, they have shown little traditional interest in its use as power, even for textiles and rice-milling which might seem obvious needs. The high and fairly even rainfalls of the upland areas are assets for water power; only in the loose materials of volcanic flanks, as in Java, is there any great difficulty about the necessary damming. On the other hand, where the rivers have water enough and suitable relief, they are remote from the centres of greatest population concentration, where a labour corps is available. Hence of the 6½ million horse power estimated to be available from the waterways of the East Indies islands, hydro-electric stations with only a capacity of .2 million kilowatts had been installed and three-quarters of them were in Java. Outside the equatorial zone, the irregular régime of rivers renders them less suited for water power, and scarcely any hydraulic power is developed in Burma, Siam and Indochina. A single installation derived from a dam at Chenderoh across a major stream, the Perak River, motivates many tin mines of West Malaya. On the other hand, electrification (from imported coals) has become widespread throughout the urban centres of the whole region. It is possible that a dispersed industrialisation based on water power might rapidly develop on lines apparent in parts of Central Europe, and Southeast Asia might, by industrialising on water power and heavy oils, skip the phase of steam industrialisation through which both Europe and Eastern United States passed. On this basis the bauxites of Southeast Asia could come into full exploitation.

Apart from teak extraction, Southeast Asia forests have provided little international trade, which is more remarkable now that

the resources of temperate forests show signs of exhaustion. The defects of tropical forest for a timber industry have been explained; it is not clear why no interest has been shown in a pulping industry based on tropical trees most of which have the advantage of relatively quick natural replacement. Pulping of tropical woods may yet solve the world paper shortage, especially as woody or fibrous tropical plants might be cropped for pulping instead of depending on predatory deforestation as is the case in the pulping industries of temperate areas today.

The forests, however, supply the basic domestic fuel of the region. Apart from westernised suburbs of the town, charcoal and wood are the normal means of cooking, in which respect the domestic life continues today much as it did two or three centuries ago. Wealthier residences may use electricity which is mostly steam-generated from imported coals, but domestic coal-gas is uncommon. Domestic heating, of course, is a question which does not arise in these climates. For their illuminants the bulk of the people turn to their trees, to coconut oil, second to which is paraffin oil from within the region. Urban areas are electrically lit.

From Commodity Production to Local Processing

Because the production of primary agricultural commodities like rubber, copra, medicinal plants, and tapioca, all the basis of industrial processes elsewhere, has been the function of Southeast Asia territories over the first third of this century, culminating in an immediate prewar export valued at nearly $1,000 million per annum, processing and manufacturing of these commodities may cease to be done overseas and become the basis of industrialisation within Southeast Asia to make use of local power resources and of the margin of time available among rural populations. A tendency in this direction was very evident in Java where skill and incentive were present; rubber goods, textile printing, preparation of medicines, confectionary and refining essential oils had grown to significant proportions by 1941 and the enforced isolation of the war years should have intensified them, though a resumption of normal trading relations will oblige these industries to so organise that they meet the rival processed goods of zones as varied as India, Europe and the Far East. The influence of India as a source of manufactured goods was evident, particularly in textiles, before the war and could become even more prominent after India's

additional expansion under the almost autarchic conditions of the war period. Political instability within India can, however, offset this advantage.

It is to be noted that the great markets for goods manufactured from Southeast Asia commodities so far have been in Europe and the United States. The little nations of Southeast Asia seem ill-prepared to absorb much of them for some years. Because food is produced in such large quantities in this typically agricultural zone, we may not overlook the possibilities of manufacturing foods in forms such as biscuits, jam and canned varieties. Hitherto the tight association with industrialised colonial powers has to some extent dissuaded intense application to the miscellany of industrial productions possible in Southeast Asia, yet the local nationalisms and the incentive to establish more balanced social and communal systems tend to encourage local industries. Burma, Siam and Indochina before the war were only lightly touched by these tendencies to manufacture.

From the point of view of the rest of the world, a re-orientation of the tremendous quantity of Southeast Asia's primary agricultural materials now handled by processing industries already established in Europe and the United States, would have major effects, not least on the ability of those industries to maintain their manufactured exports at levels which have been increasing over the last century. Thus, a nationalistic Southeast Asia driving towards self-sufficiency industrially is likely to diminish the international trade streams to and from this region, though it may progressively increase the occupational activities and living standards of Southeast Asia people.

Intra-Regional Trade

A total value of about $400 million was involved in the prewar interchange of goods and commodities between one part and another of the Southeast Asia region. This intra-regional trade was relatively small because the component units of the region produced much the same commodities and goods, by reason of which the countries tended to be rivals rather than customers of one another. An additional factor was the pull of several metropolitan areas, Britain, France, Holland and the United States, which acted to lessen intra-regional trade and to lessen the regularisation and rationalisation of production in Southeast Asia as a whole. Food

deficiencies of local people were largely met by intra-regional trade, particularly the rice and fish movements from Burma, Siam and Indochina to the other territories. The layout of the whole region relative to transocean shipping routes drew much of the intra-regional trade to major foci like Singapore, from which point manufactured imports from other parts of the world were also distributed within the region. Singapore has functioned for a long time as entrepôt centre for the region and some two-thirds of its import values derived from Southeast Asia. Siam had a very balanced trade relation with its surroundings, over 40 per cent of both its imports and its exports being related to Southeast Asia territories.

Extra-Regional Trade

The overall trade movements from the region to the rest of the world were huge; annually over the quinquennium 1936-40 commodities valued at well over $2,000 million went overseas from Southeast Asia and some $1,200 million of goods moved into the region, quite apart from the intra-regional trade. The disparity of values moving in and out of Southeast Asia has for years been paralleled in the trade of each country, the disproportion being least in the case of the Philippines and greatest for Burma. The disparity went deeper; since the Southeast Asia output was of bulky, raw or partially-processed commodities, the outgoing tonnage far exceeded the incoming tonnage and the carriage involved made Southeast Asia one of the busiest oceanic shipping areas of the world, an activity swollen further by the great amount of coastwise shipping made necessary by the insular character of the region. It was largely the absence of this shipping which paralysed the region during the war years.

By 1947, re-establishment of trade flows was becoming apparent, though Indochina and the East Indies were still largely isolated. Southeast Asia commercial activity then showed a new pattern: about $3,500 million of goods went into the region as against $2,500 million passing out. While these figures included both intra- and extra-regional trade, they were mostly the latter; they involved an entirely new valuation of goods and a substantial addition could be added for "black" or unreported trade.

Nevertheless, the overall figures showed that Southeast Asia was absorbing far more in value than it was exporting. Part of the

disparity could be attributed to replacement of capital equipment, yet it may indicate the beginnings of a great change in the function of Southeast Asia in world trade. Postwar revival by 1950 had become most spectacular in Malaya which, though the smallest political unit of the region, had re-established its trade and was responsible for nearly half the total trade of the region. The Philippines also recovered quickly, to be involved in a quarter of the trade.

Convergence of Routes

This region stands at zones of convergence for transoceanic routes between the very densely populated areas of India and China, and also between those areas and Europe, Australia and North America, so that international shipping is likely to converge upon Southeast Asia independently of purely colonial considerations which have hitherto specially drawn the Philippines into the U.S. shipping circuits, the East Indies into the Dutch, and the rest of Southeast Asia into the British shipping streams. French shipping has been relatively little involved, certainly not more than Danish, Italian and German and far less than the Japanese.

The convergence of shipping routes has left a heritage of convergent air routes which are tending to follow closely the shipping lanes, making Southeast Asia the terminus of the air lanes from North America down through the belt of narrow seas along the West Pacific (linking the United States with Japan, China and Java population centres) and from Europe across the "Eurasian Mediterranean" of Southwest Asia and India, as well as a junction for lines to Australia, although the population and production of the latter scarcely justifies considering it in the long term as a major objective of airways in the way that India and China must continue to be.

Convergence of Interests

There is thus much to be coveted in Southeast Asia, the raw materials and the food it produces, the manufactured goods it needs, the commission on the coming and going involved, are all desirable and those who share or have shared in its $15,000 million 1950 trade turnover are inevitably defensive of their portion. Colonial powers have jealously divided up these assets in the past and it is to be expected that there will always be from India and

China no less than from Europe and America, rivalry to share the trade of Southeast Asia.

Southeast Asia has been for a long time divided up by divergent colonialisms. Its prospect is to be divided within itself by divergent nationalisms which leave it only too open to the covetous from East and West, more particularly as Southeast Asia is the only zone providing a surplus of rice and the only zone likely to absorb even the shoddiest of cheap mass produced articles. From now on it is not only the western manufacturers who seek the great markets of Southeast Asia. The factories of India, China and Japan will be equally interested to enter this market—all of which suggests that the trading interests convergent upon Southeast Asia may increase rather than decrease.

Asia and Southeast Asia

In its relation to the rest of Asia, Southeast Asia has functioned chiefly as a source of food (rice from Burma, Siam and Indochina, and sugar from Java) and of money derived from Indian and Chinese remittances sent back to their homes by traders and labourers in the pioneer mining and planting zones. So far the region has been the only population and food "safety valve" for Asia, and the only "New World" for the teeming populations of India and China. Possibly it can continue to function in the same way for some time to come, but the food margin in Southeast Asia is decreasing. Other Eldorados of migration and food have in the past rapidly become overpopulated areas, needing imported foods—the rhythm of such a change-over may prove specially fast in a tropical region. Developments of the last century in Burma, Siam, Malaya and Java have certainly shown how rapidly changes can be brought about and how when certain types of pioneering and initiative are concerned, the people of these territories are capable of large-scale action. Directed into forms of cooperative rural and industrial activities aptly fitting their traditional subsistence farming and communal mutual assistance systems, their rate of industrialisation may prove as remarkable as their rate of commercialisation of agriculture over the last fifty years. Just as commercialised agriculture on its own has produced disruptions and breakdowns of many aspects of local life and reduced it to a degraded form, so also industrialisation without planning to fit in with the ecology of Southeast Asia may reproduce for long periods only the more

sordid phases of industrialisation from which the West is just starting to emerge. Commercialised agriculture in Southeast Asia has led to rural slums; industry uncoordinated with this special environment may merely bring squalor and bad living conditions which it has taken years to eliminate from the older industrial centres, but which can easily go on for much longer in a more ruthless oriental setting.

Chapter Twenty-five

PEOPLES, POLITICS AND PROSPECTS IN SOUTHEAST ASIA

THE setting of Southeast Asia may be summed up as one of extremes of relief (deltaic plains and mountains) and a climate mostly approaching the wet limit for plant life but merging into monsoonal types. To this setting the people have made varying responses, ranging from migrant food gatherers and hunters in the jungles, to subsistence farmers in the plains, but all turning upon woody materials for weapons, implements, house-structures and domestic utensils, upon rice, the cereal of the wet extreme, and upon social systems of communal help. The whole social and economic life has been galvanised over the past century or two by being more and more drawn into commercial and industrial activities developed in response to and on the basis of external needs for the minerals and agricultural products of Southeast Asia, whereas prior to that time the region was touched only by a trickle of traders moving between India and China.

FACTORS IN THE HISTORICAL GEOGRAPHY

Several factors account for the difficulty of obtaining firm data to fill in our general picture of the historical geography of Southeast Asia. In the first place, there grew up no strong literary tradition to last through the centuries and record the past in a form other than mythical. Here tradition is largely oral and literature essentially Indian rather than indigenous. And whatever there was of local record and history has rotted away quickly, the climate, the ants, insects and moulds soon destroying anything on wood, paper, leather or cloth. Moreover, in this setting of swamps and forest, the most easily available material is wood, and artistic tradition expressed in wood, whether in carvings, buildings or tools, rapidly disintegrates, leaving little of that sort of evidence which is the basis of our facts about early periods in other regions. Buildings and carvings on stone were not normal expressions of Southeast Asia people where over large areas stone is not easily come by and where

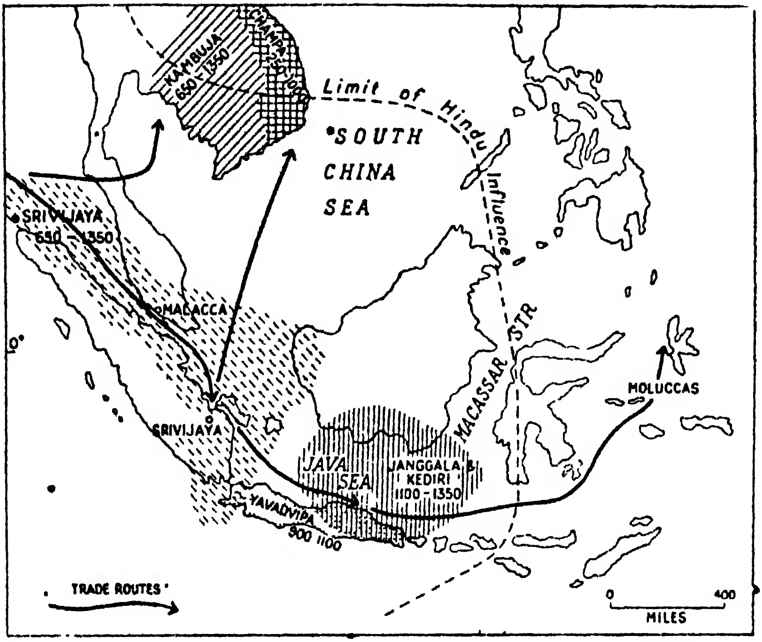

FIG. 113.—Historic Pattern of Southeast Asia during Indian Colonial Period

implements had not in any case developed far enough to deal with stone. Hence monumental evidence in Southeast Asia is so largely Indian, an introduction by foreigners using styles and techniques developed in their home settings, and most developed in the drier parts of this region, where stone is more accessible. On the clay lands, historic brick structures, also an Indian innovation, weather to nothing very quickly. At Angkor may be seen the power of quick-growing tropical trees to shatter and break down temples and palaces built of stone and lateritic blocks.

This, too, is a region of natural calamities, difficult though it is to pin-point them. Little kingdoms have been wiped out in a few hours by Javanese volcanoes, as in A.D. 1006 when the flourishing city of Dharmavamsa (a great king of Central Java) was reduced to ashes by "a great calamity," probably an explosion and lava outflow of the Merapi volcano. Settlements along rivers have been obliterated when huge mud-flows swept down from loose ashes on the flanks of new eruptions, possibly accounting for our ignorance of east Sumatran kingdoms. Coasts have altered through the years

and deltas have changed; areas which once were shallow sea have become sedimented to swamps, a process by which Cambodia has been cut off as the Lower Mekong built up mud-flats isolating Tonle Sap from contact with the sea. The evolution of new routes has caused some old centres of power to fade into mere fishing villages, evidenced in the decline of Takhola and Bandon after the sea route through the Straits of Malacca became more generally

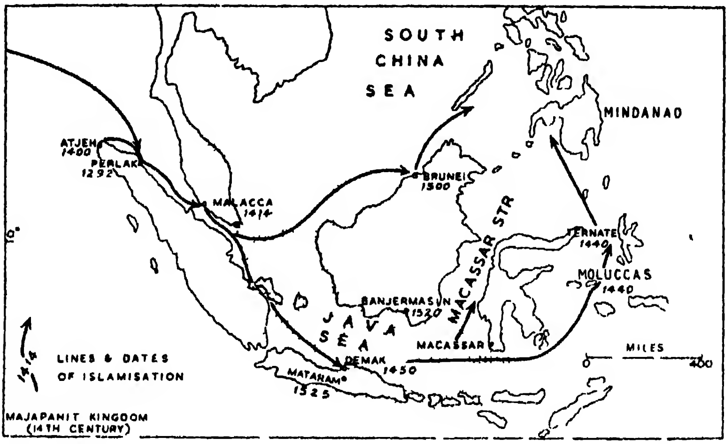

FIG. 114.—Historic Pattern of Southeast Asia at the Islamisation Period

used than that across Kra. Plagues have laid waste whole cities, as when Uthong in about 1350 was devastated by cholera and its population fled. The region is still one where malaria, dysentery, cholera and plague are endemic, more especially in the older, more congested territories like Java. These diseases have frequently flared up into appalling epidemics killing thousands of people, epidemics reflecting a relation between bacteria and the climate (which encourages bacterial reproduction), the population density, the difficulties of sewage disposal and social habits of indifference to hygiene (which has no ill effects among lonely settlements in the forest but becomes a social menace in towns). Fevers and virulent diseases have frequently ravaged the local people, debilitated them, and wiped out their settlements. The region is strewn with ruins of towns now abandoned, and with ruined groups of people who have degenerated physically by disease and under-nourishment. Southeast Asia proved capable of engulfing rather than enshrining those moving into it to live.

Further to complicate the historic geography was the fact that the literary people, the monks and religious men, were Indian or Indian-minded for long periods, disinterested in mundane records, and following the custom, still evident among many Southeast Asia people today, of avoiding personal names, so that anonymity, obscurity and confused nomenclature veil the past even in such records as do exist. Many experiments in writing styles were developed among these isolated and complex peoples and often inscriptions made in them cannot be translated today. Because of the dispersal tendencies within the territories themselves and the lack of focus to the region as a whole, no great depositories of learning were established in Southeast Asia to gather and conserve the record of its past.

Population Changes

Broadly speaking, the region has been until recently one of very thin population and large patches of it still contain populations of remarkably low density. Direct evidence of densities are scanty for periods farther back than this century, yet it seems probable that the whole of Southeast Asia in 1800 contained only about ten million people, when the region was probably as thinly peopled in its most attractive areas as Upper Burma and Upper Siam, the least attractive and developed areas, are today; Malaya then contained about a quarter million people, Java about four million, Burma probably less than two million. It was, even at the end of the 18th century, a zone of labour shortage and the objective of the local princelings of the times was to get hands, the basic power resource of their time, the one way of securing a small surplus from their fundamentally subsistent territories. Outsiders were not greatly attracted to Southeast Asia itself, as apart from the routes through it. To Spain its old colony, the Philippines, was no great asset and more related to Mexico than to Spain, remote and ready to drop from the Spanish orbit during the 19th century. To Holland, its colony in Java was a company venture that yielded little direct profit for many years and was at times on the verge of bankruptcy.

But the last 150 years brought tremendous changes in population. First, on the heels of the Industrial Revolution in Europe, came a revival and an expanded volume of trade between the Indian Ocean and the Far East, a stream which threaded the seaways of

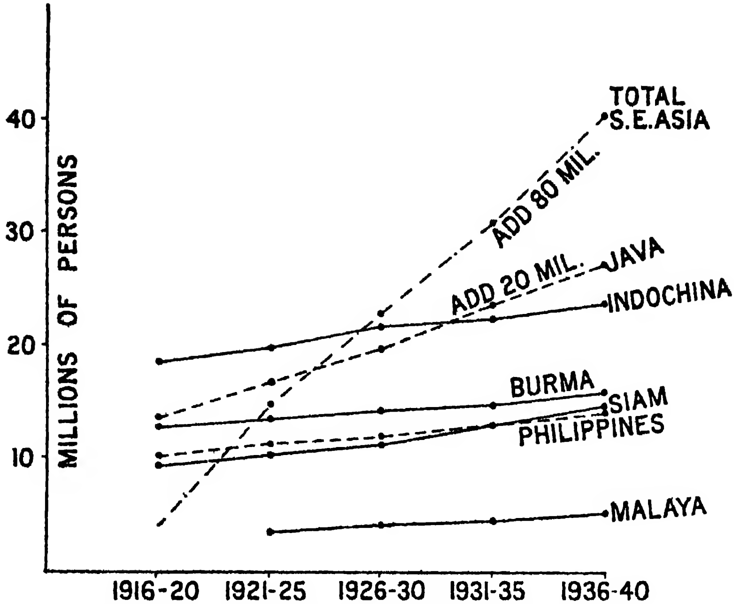

FIG. 115.—Population Expansions of Southeast Asia

Southeast Asia, diffusing new conceptions as it passed, re-establishing trading centres, drawing out the produce of Southeast Asia people and stimulating development of Southeast Asia as a source of trade rather than a passage for traders. It has been a century and a half of tremendous population increases, causing people to swarm upon the more fertile areas, upon deltas and volcanic cones where people had not clustered before. In these choice areas, the new deltas and the newer ejecta, the bulk of the great population increase has concentrated, so that upon them live teeming multitudes in limited zones separated by stretches of forest-covered space scarcely more populated now than they were several centuries ago. By the quinquennium 1916-20, the total population of Southeast Asia had become 84 million, by 1936-40, 120 million, and in this present quinquennium (1946-50) it is nearly 145 million. The increases, while general, have not been even (Fig. 115). Over the present century, of the political units, Java has been increasing very much faster than any other, and Siam has since 1911 so increased that its population exceeded that of the Philippines by 1933 and by now exceeds also that of Burma.

SOUTHEAST ASIA NUTRITION DENSITIES
(Average number of persons per rice-acre per annum)

Quinquennium	*Burma*	*Indo-china*	*Siam*	*Java and Madoera*	*Philip-pines*	*Malaya*
1916–20	1.23	1.75	1.66	4.12	3.13	
1921–25	1.19	1.67	1.57	4.27	2.67	5.61
1926–30	1.14	1.61	1.57	4.50	2.69	6.13
1931–35	1.19	1.64	1.63	4.60	2.76	6.42
1936–40	1.25	1.63	1.74	4.96	2.79	7.02
1946–50	2.0	2.1	1.6	5.9	3.9	7.2

Because population and the net production of food have increased *pari passu*, it is important to examine the "nutrition density" (persons per acre under rice) since the surplus for export depends on low internal consumption of the Southeast Asia staple and high internal production. The countries of Southeast Asia pre-war showed considerable differences in nutrition density, from Malaya (the plantation-mining specialist) with 7.2 persons per rice-acre, to Siam (the rice-surplus specialist) with 1.6. Malaya, Java and the Philippines had nutrition densities much higher than the rest of neighbouring countries and in the case of Malaya and Java the nutrition density had been steadily rising, whereas in Burma, Indochina and Siam it was fairly static. Over the same period, the domestic consumption of rice per person sharply dropped (by 20-25 per cent) in Burma, Siam and Java and rose about 10 per cent in Indochina, Philippines and Malaya. The postwar figures available show considerable increases of nutrition density everywhere except in Siam, yet these were changes of degree, not of pattern.

Changing Internal Emphasis

Today the very crowded places are firstly, Middle and North Java, Lower Siam and the Red River Delta, where densities of over 1,500 people per square mile occur, with secondary crowdings in Lower Burma, the Lower Mekong, Central Luzon and the Visayas. These concentrations of people are pre-eminently in agricultural areas (Fig. 116), and they are in fact largely made possible by exceptional soil qualities within an area whose general soil fertility is low. These crowded areas have taken part in a commercialisation of local agriculture and their subsequent history has been firstly a

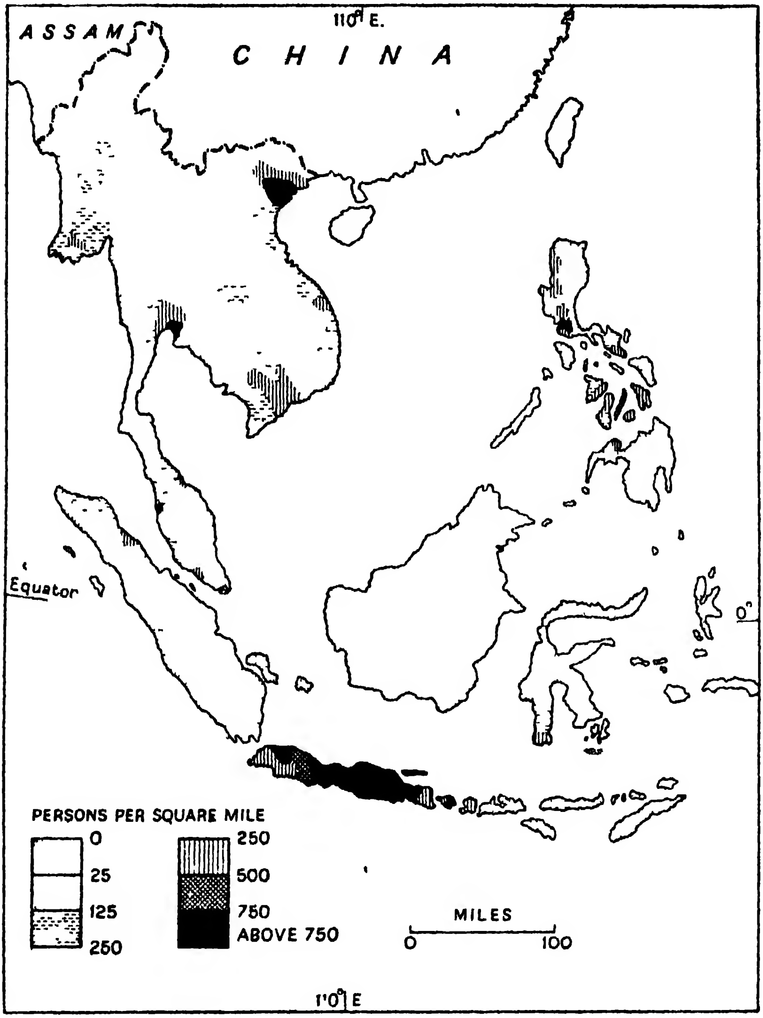

FIG. 116.—Distribution of People in Southeast Asia

rapid increase in people to a point where the new agricultural development ceased to be enough for the large population, leading to the second stage of slow migration and emphasis on commercial agriculture upon newer zones of similar type. Hence the change of emphasis from Tonkin to the Annam coastal plains and then to the Lower Mekong; from the Central Luzon area to Visayan Islands;

from the plains of Java to the dangerous upper limits of the volcanic country; and from Dry Burma to the Irrawaddy Delta. Sometimes there has been a little agricultural migration—very largely this change has been brought about by different rates of growth rather than movement of people to new places. Everywhere commercialisation of agriculture has led to population increase, because the agricultural technique has not changed from the Southeast Asia tradition of manual work at every stage. The bringing of new areas into cultivation has been followed by an increase in the number of hands to do the cultivating, partly a response to the need and partly made possible by additional nourishment and an added vitality arising from lower disease rates natural to the less populated area, because human diseases are diffused more slowly where people are isolated from one another, as in new areas. Thus Southeast Asia has been the scene of intense pioneering by people seeking, developing and filling new agricultural areas, to create for a time the eldorado of rice-eating peoples and the one safeguard of Indians and Chinese against the vagaries of their own harvests and against the congestions of their home districts.

Minerals in turn have attracted external interest. There has been the pull of gold in the Philippines, of tin in Malaya and nearby islands, of petroleum in Sumatra and Borneo. These great gambles drew capital and pulled in crowds of labourers, wage-earners who were unavailable from local people so tightly held in their manual agricultural systems. Minerals drew millions of Chinese through the South China Sea in the tin rushes and oil rushes of the last hundred years.

Yet another form of commercialised agriculture developed, to provide the industrial raw materials of distant factories in Europe and America and based on crops entirely foreign to Southeast Asia. Sugar, coffee, hemp, rubber, oil palm proved highly successful in this terrain where they had never existed before. Large plantations of them were laid out, still more wage-earning labour was absorbed, a still greater production was obtained, drawing more and more people into virgin areas. Migrations from India and China were further stimulated to work upon the plantations whose uneven development, in successions of booms and depressions, alternately attracted migrants in the boom years and sent them home again in the depressions.

Political Convergence

These local products for commerce not only stimulated export trade; they stimulated import trades to feed the migrant peoples, to dress them, and to dress the agriculturists so preoccupied that they could no longer spare time to weave for themselves. And trade itself drew external interests; Chinese and Indian traders came in to monopolise middleman functions and Europeans came in and worked out here the complex balancing of their own industrial systems far away. Britain stimulated the commercialisation of Burmese rice production as an assurance of cheap food for an industrialising, overpopulated India. The Dutch fanned out from Java into the adjoining islands. Not to be outdone, the French moved into Indochina as a base for their China trade. Germans for a time controlled the copra trade of the farther eastern islands. Thus all the major Western European powers had colonial interests in the expanding peoples, the expanding production and the expanding needs of Southeast Asia. And the major oriental powers, India, China and Japan, had equally direct interest in Southeast Asia (Fig. 117) as an outlet for their people, a source of rice, a source of raw materials for their industries, and finally as outlet for their own industrial products, India and Japan being mostly involved in this, the latest phase.

Internal Divergences

The resulting pattern of people is one of unparalleled diversity in stages of evolution from subsistence to commerce, in densities of people, in ethnic types, in languages (Fig. 118). The similarity of setting, circumstance and products have disrupted Southeast Asia within itself by economic rivalry in producing similar commodities, and the divergencies of overseas connections with different colonial powers established divergent trade streams, currency differences, educational differences and political differences. Political and economic forces released in Europe and America had their repercussion within Southeast Asia, by means of which French protectionist policies virtually isolated Indochina from its neighbours and Filipinos turned their backs upon Asia. Siam has been wooed, ignored or bullied, depending on the fluctuation of Anglo-French relations in Europe and the opportunism of the U.S. in building up its bloc in East Asia. All sorts of colonial systems have been

FIG. 117—Pattern of Modern Migrations

experimented with, so that Southeast Asia has a great range of constitutional forms, from fossilised oriental aristocracies to democracies of a few intelligentsia and to would-be republics trying to combine the gestures of democracies with the powers of autocracies, the whole being permeated by complex trading systems of both Western and Oriental types. All this may be summed up by saying that the cross-currents and backlashes of the world's political and economic systems of the present and past still move

through Southeast Asia, irrespective of what the parts of Southeast Asia may have in common and overriding their traditional differences.

Every human type is represented in Southeast Asia. Successive peoples from East-Central Asia have filtered overland from the north, ranging from primitive Australoid types who left a few

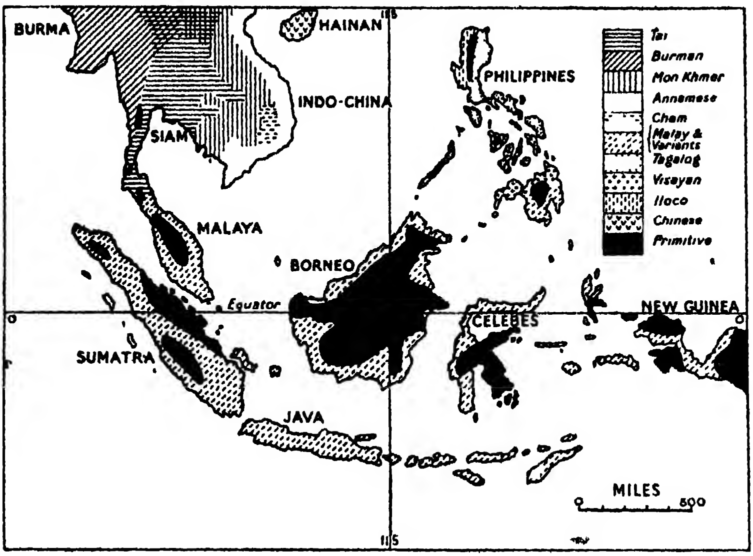

FIG. 118.—The Pattern of Languages in Southeast Asia

Negrito and Australoid people in the forests as mark of the greater stream which went island hopping to Australia, to the later Tibetan-Mongoloid peoples, forefathers of the Burmese, Siamese and Laos of today. Then there were centuries of Indian migration early in this era, pressing overseas from South India across Kra, along the coasts of Sumatra and Java, into Lower Siam and the Lower Mekong, leaving an indelible mark in the speech, culture and religions of people there today; this was a spread of Indian merchant adventurers and traders, and large-scale colonies exclusively of Indian settlers seem not to have been established, but in time there took place a great blood mixture between Indians and the older indigenous stocks. Later came a similar seaborne migration into Southeast Asia by predominantly Chinese people who first trickled south in the manner of sea gipsies, developed agricultural colonies

as in Tonkin and merged with local people, followed later in our times by a stream of traders who started by being dealers in the India-China trade and became in time traders between one Southeast Asia people and another. Thus the migration to and settlement in Southeast Asia of millions of Indian and Chinese labourers over the last fifty years or so (Fig. 117) is the modern expression of a process of convergence which has been going on for some two thousand years, differing only in that these latest migrants aimed to be temporary even though a portion of them never returned to their home countries, staying to marry and help change the character of Southeast Asia people. The predominantly Indian stream moved east and south to a northern limit roughly running through Cambodia—Lower Siam—Lower Burma; the Chinese stream moved into Luzon, into Borneo, Siam, Cochinchina, into the coastal fringes of Malaya, Java and Sumatra, into Lower and Northern Burma. Never has any one people or any one power controlled the whole of Southeast Asia until the Japanese period 1942-45 which, repeating in form though not in character the Chinese migration, demonstrated a unity only of paralysis not of invigoration.

Plural Societies

Thus, though the ethnic types converging upon Southeast Asia have been of separate groups, they have extended over different lengths of time, with the result that the region's ethnic map shows different degrees of their absorption into the Southeast Asia setting. In some places the absorption is complete, in others it has scarcely started, and there are all variations between. Hence the units of Southeast Asia are peopled by a range of types from indigenes to raw immigrants, each with specialised functions in society, so that no unit is homogeneous horizontally: there are great variations of custom, speech and stock from one part to another of the same layer of society; or homogeneous vertically, because there are generally communal differences between wage labourers, peasants, traders, administrators and aristocrats. Sometimes a religion is the only link. In certain cases, education by the colonial power is the chief link—as among the people of Indochina and the East Indies. These conditions, added to the wide range of economic interests, mean that each political unit repeats in miniature the variety of peoples and interest which is typical of Southeast Asia as a whole.

The dualisms and pluralities of Southeast Asia society are relatively modern, becoming emphatic only over the past three hundred years, but plural societies and changing values within the units have been apparent in their changing political patterns. First there were the inland political nuclei; the kingdoms of Middle Burma, Upper Siam, Inner Cambodia were matched among the islands by principalities set in the mountains of Sumatra and Java. Then came the little powers related more to the sea than to the land; the Sailendra kingdoms using the Malacca Strait as their bond and artery, the Majapahit sea kingdom whose territories in Borneo, Celebes, Java and South Sumatra may be thought of as footholds for a sailing people, fringing rather than entrenched in the islands (Fig. 113). At a later phase the move of power centres was to the lower rivers of the continental edge, to Lower Burma and Lower Siam. In these historic patterns of political units may be seen operating the influences and traditions of widely differing human types, one rooted in the land, coming overland, depending on agriculture for its welfare and power; the other of seafaring people, many kinds and grades of them, coming to the lands of Southeast Asia by water, relatively mobile on their seaways, fishing and trading through the seas, and always peripheral to the land.

Dual National Foci

In most of the constituent political units of Southeast Asia there is thus a split of interest (Fig. 117). Burma has a focus at Mandalay and a commercial-administrative focus at Rangoon; the Philippines has a dual nodality round Manila and round the Visayan Islands; Malaya, which has only recently acquired clear internal focus, has two centres of different interest, Kuala Lumpur and Singapore, the former exclusively peninsular, the latter as much involved with all Southeast Asia as with Malaya; Indochina has the double pull of the Tonkin (Hanoi) area and the Mekong Delta (Saigon); Java, its old internal focus at Jogjakarta, with Batavia acting as external point of attraction. Sumatra is in the strange position of having several inland nuclei plus the tendency to use Singapore as its outport and route to Batavia. Only Siam can claim to have no second focus, yet even there the channelling toward Bangkok is only natural for the Chao Praya Basin; the Korat Plateau topography leads human and commercial interests towards the Mekong and the border country towards the northwest was once focused on

the historic kingdoms at Chiengmai. Borneo is laid out so far entirely under centrifugal influences, complicated by the split into British and Dutch zonations.

If this "balkanisation" be true of the individual political units, it is equally strong in the region as a whole, except that the intersection of major seaways and airways tends to make an internal regional focus on Singapore, a tendency diminished by India's economic pull on Burma and South China's pull on the people, trade and foods of Siam and Indochina.

To some extent these dual foci to each territory have been stimulated by the arrival of Western trading systems which pulled in one direction while the traditional interests pull in another, yet in a sense all these political units have been created by colonial powers administering as a unit territories not previously politically unified or previously using the present boundaries. Spain and the United States enforced unity upon what is now the Philippines and in practice had continued difficulty in keeping Mindanao, for example, within the unit. France has imposed a uniformity and a certain coherence upon Indochina which was novel to the constituent units. Malaya as it exists today is a British political creation. Before the Dutch colonial period of the present century, all the islands of the East Indies had never been controlled as one whole.

Environment and States

The continental political units, Burma, Siam and Indochina in some ways may be likened to little Egypts—nucleations of people within attractive, fertile valleys protected in these cases by the nearly empty space of forests and mountains. The combination of natural encouragement and natural protection conditioned major civilisations in Egypt and in Mesopotamia at one phase in history and appears to be equally encouraging in this tropical setting except for one difference, that although this environment on the southeastern fringe of Asia certainly suited the growth of states, its protective isolation was incomplete. In the north the growing riverine states were exposed to intruders. Thus in these riverside nurseries, states were environmentally encouraged to grow in a setting attractive as breeding grounds for nations, though the environment was not sufficiently isolating nor sufficiently protective to enable the nascent states to persist. So far as the main islands were concerned, on our maps they appear as more emphatic units

than their elongated forms, difficult interiors and cliffed, marsh or forest edges in fact justify. Rarely has any one of the major islands been the locale of a single people singly governed, homogeneous and integrated into an island-state. These large islands have been dispersive and fragmentive to the peoples in them.

Postwar Nationalism

The postwar effusion of nationalism in Southeast Asia is thus a paradox. It is a nationalism of plural societies and substantial minorities, without homogeneity inside the states, and without a nation, as understood in Europe, and very much a culmination of the insecurity and uncertainty produced by the divergent influences which have long been at work, breaking down old social integrations and their warm, human associations, substituting for them nothing but commerce and the new myth "economic man," cold, inexorable and not adequately or fully integrated with Southeast Asia people and their setting.

The devolution of Southeast Asia from colonial into nationalist units takes place at no propitious time. The cultivation of rice has been predatory, the accumulated effects of which are now showing in diminishing yields; new paddylands before the war were ceasing to be so easily available and the war threw a large proportion of the old lands out of cultivation. Rubber has found a competitor in synthetic rubber, and its production may repeat the history of sugar. Tin recovers from the war slowly because equipment has been lost. Plantation crops have lost labour, markets and opportunities. Yet Southeast Asia is still increasing its people faster than the world average. Its increase, however, has gone on at a slower rate in the already congested areas and at a faster rate in what had been the emptier areas of South Sumatra (with Javanese migrants), in Mindanao (with Filipinos), in Johore (by Chinese immigrants), as well as in Laos, Dutch Borneo and Inner Siam, by local increases. Thus Southeast Asia has been filling up, though there is little prospect yet of an even distribution.

Devolution

The Southeast Asia population is expanding now as the trade systems which provided its first impetus to expansion shrink and lose coherence. The atmosphere is one of relinquishing colonies, but under circumstances when they are involved in an international

bankruptcy rather than profitable, going concerns falling ripe for redistribution among new hands. Briefed in the theories and profits of a prewar economy, possibly even persuading themselves that something of the splendour of a 19th-century empire is theirs for the picking, these little nationalities are very largely liabilities, not assets. The policy of national autarchy may, under these conditions, reduce Southeast Asia to a condition approaching its low-pitched subsistence system, a reversion to the confusion and stagnation found there by the first European colonists. An era of political and material expansion has ended for a time and another of explosive instabilities has taken its place, a process of relinquishing and flinging off, possibly of disintegration. From a phase when Southeast Asia people were overwhelmed by the technological superiority of Europeans and Americans, the region is passing to one where this disparity becomes less and less. Whether or not this will prove pleasant for the people there, their leaders think it desirable, and a congenial poverty may ultimately prove the normal and agreeable thing for them, as it was in the 16th century.

How devolution will shape the political units of this region is not yet clear. Accentuating the pattern of dual foci already established, the divergencies produced by colonialisms and nationalisms, whose violent tenacity in the years 1945 to 1948 have been as disruptive as war itself, may yet produce in Southeast Asia a set of political units from which the colonial powers have withdrawn to a few key trading posts by the sea, reproducing once again that pattern once familiar as the foreign concessions (like Shanghai) on the coast of China.

The diminishing political hold of European and American colonising powers cannot decrease the interest of China and India in this area where they have had traditional influence, whence they have derived great profits in the past, where many of their nationals are, where raw materials for their own industries can be obtained, and where the one rice granary of Asia is. It is difficult to avoid supposing that, whatever the sentiment they profess, India and China in varying degrees may become involved with the control of Southeast Asia no less intimately than the colonial powers have been. Possibly this marginal, internally disrupted zone can only exist as an appanage and countries there may become the colonies or satellites of Asiatic powers rather than independencies.

In the readjustment of political, economic and social forces now

going on between the relinquishing of colonial power by one set of foreigners and its replacement by another or by indigenous party groups, it is to be expected that processes of merging and re-shaping the states may occur, because the metropolitan powers had, in effect, frozen Southeast Asia into a set of political units which bore little relation to readjustments they caused to take place in Southeast Asia and more to considerations of policy and industry in Europe and the United States. Nationalism and its social policies may first result in a pulverisation of Southeast Asia into very small political units until complementary components to a state are realised to be no less important to a government than nationalistic units, which consideration may then lead on to a re-grouping of the small units into large ones differentiated internally but integrated as complementary parts of a nearly self-sufficient whole. Whether such fissions and re-groupings will be by arrangement, by force from within or by compulsions from without, depends as much on the persons thrown to the political forefront as on qualities inherent in the many-dimensioned pattern of Southeast Asia's political geography.

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